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ACCURATE COMPOUNDING.

Compound wound direct current dynamos are extremely convenient for the automatic compensation of the many factors that tend to reduce the voltage across the lines of multiple systems with increase of load. With the improved economy of the modern incandescent lamp comes a demand for more constant potential, and hence for more accurate compounding. It has long been recognized that the over compounding of a group of machines in multiple is inversely proportional to the number of machines in service, whereas it ought to be independent of this factor. It has generally been thought that this could be simply remedied whenever necessary by leaving the series fields of the whole group in circuit continuously, whether the machines on which they were wound were in service or not. The consideration of a concrete case will show the falsity of this conclusion. Assume three similar machines, giving a 9 per cent. drop on full load with their series coils out of service, and over compounding 9 per cent. on full load with their series coils in service. If the rated load of one machine is divided among the three, the series coils will build the voltage up approximately 6 per cent. above that given by the shunt coils alone, and there will, therefore, be a drop of 3 per cent. from the normal voltage on this load instead of the actual rise of 3 per cent. which should be generated to compensate for line drop.

In large direct current plants, where storage batteries are used, the battery, as a rule, is equipped with a differential booster, so designed as to boost the battery voltage with increase of load just sufficient for a proper division of the work between the battery and the dynamo. Sometimes it is desired to divide the work in the same proportion at all loads, but, as a rule, it is considered desirable to make the battery take all the fluctuations and render the load on the generating system constant, owing to the increased steam economy of this course. With the two over compounded systems in multiple, namely, the generating system and the battery system, it is essential that their relative compounding curves should be independent of any disturbing factor, such, for example, as the number of machines in service. With the low resistance generators and the still lower resistance batteries necessary for economical service, the compounding curves must be carefully adjusted to each other or serious disturbances will arise. With the accepted compounding arrangements the ratio of the compounding of the dynamo system is changed every time a machine is started and stopped, and the same would be true if the series fields were all left in circuit continuously.

In another column Mr. George T. Hanchett gives a solution of this difficulty, requiring only two series windings on each machine; one to balance out the fall of voltage arising from the action of the machine itself and its driving generator, and the other to effect the over compounding and thereby balance out the drops in the feeder and distribution system. While this complicates the field windings of the generators somewhat, a modification is possible which will overcome this, namely, the placing of the compounding coils on every alternate field core and the over compounding coils on the intermediate cores. It is not at all necessary that the field windings be uniformly distributed between all the field multipolar cores. A machine will run without internal unbalancing if the whole field excitation is effected on alternate cores. It is only necessary in multi-path machines that the flux through any one core is equal to that through each of the other cores of the same polarity.

MUNICIPAL OWNERSHIP OF ELECTRIC LIGHT STATIONS.

The discussion of the questions concerned in the municipal ownership of electric light stations has been carried on with much bitterness for a long time. A certain amount of experience has been accumulated by municipalities which have experimented with public ownership and this has been, on the whole, very encouraging to the advocates of private ownership of such stations. It has been repeatedly charged that municipal officers in making their reports upon the operation of plants under their control have not included such items of taxes and depreciation as would be necessarily involved in the balance sheet of a private corporation, and that, consequently, such figures as have been circulated are unreliable and worthless for comparison. On the other hand, the advocates of public ownership and control of such works point to the excellent results attained under municipal management in England, and advance arguments which have much weight with the laity to support their contention.

The question is really a simple one. Broadly stated, it is whether or not a city can own and operate its own electric light plant with profit and advantage, or whether it is better for it and its citizens that electric current should be furnished by a private concern.

To the first question above the answer seems to be a very vigorous negative. The reasons involved are first, the practical certainty that such a plant would sooner or later be turned into an oppressive monopoly; second, that no city can obtain the same amount of labor for the same price as can a private corporation. Further than this, the ever-present temptation for political leaders to make places in the plant rewards for partisan service would in time deteriorate its personnel. Under private ownership the remedy for oppressive charges is always at hand in the possibility of competition, either by a second lighting company or the city itself. No corporation can long exercise a hurtful monopoly of the situation to its own profit. Sooner or later such a course must lead to the appearance of a rival—a fact well illustrated by the recent growth of opposition telephone companies.

Public office, no matter how humble its nature, is too generally regarded as a sinecure in this country. The consequences of this feeling and the political importance of labor unions render it a practical impossibility for most cities to obtain labor at the lowest market price. Even assuming that a municipal plant is controlled by a commission of competent and irreproachable character, the large cost of labor must be reflected in the rate of charges, while the frequent changes in the personnel of the management, due to changing administrations, can only be productive of an unsettled policy and in the end a condition of affairs that would not be tolerated in a private enterprise. Against a municipal monopoly the citizen has no remedy whatever.

The cry of "socialism" is often raised by those contending against the establishment of a municipal plant, especially by those who ignorantly confound socialism with anarchy and communism. As a matter of fact this is a poor argument. All the citizens of a community do not use electric light. The plant must either make money or lose money, since it is physically impossible to so administer its finances that it balances income and expenditure exactly. In the case of a profit those who use and pay for its product are taxed for the benefit of those who do not, while in the case of a deficit the whole community is taxed for the benefit of users of electric light. Thus the operation of such a plant is essentially inequitable.

The electric light companies are themselves largely to blame for the popularity of the municipal plant idea. They have very generally occupied a position of antagonism to the government of their cities and endeavored to make up for losses in other directions by a tremendous profit on street lighting. In their dealings with boards and councils they have too often shown a grasping spirit and this is now recoiling upon them in the agitation for municipal plants. Any demagogue can obtain popularity by an outcry against excessive electric light tariffs. After the fashion of his kind he does not hesitate to plunge the municipality into the uncertainties of a business in which depreciation is still largely an unknown factor, and into an expense of which no one can see the end.

The morality of municipal plant building in towns where an electric light company is already in operation is open to very serious question. The nature of the right acquired by a company which has expended its money and built up a business is perhaps not legally definite, but it is certainly morally definite and its invasion cannot be defended upon ethical grounds. In towns where no electric light plant is in existence there seems to be no moral reason to restrain the municipality from trying the experiment, but the risk involved is so large, the expenditure required so great, the danger of future dissatisfaction so imminent, that it is only in places where the counsels of common sense are not heeded that the trial is likely to be made.

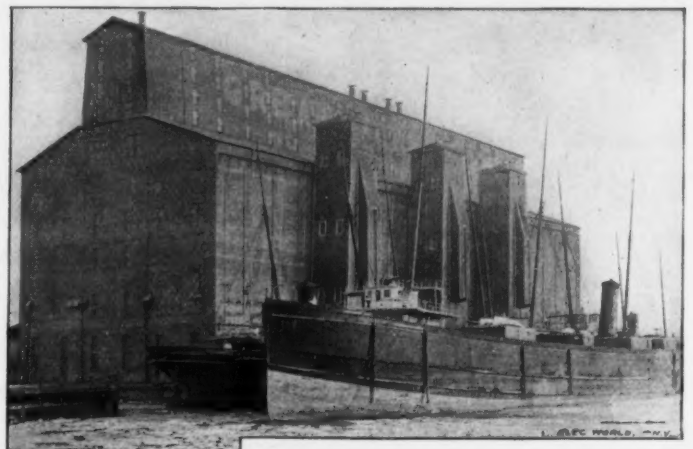
THE MUTUAL REACTION OF ALTERNATING DYNAMOS.

When two direct-current shunt-wound dynamos are thrown in multiple they mutually adjust their speeds of rotation, so that the E. M. Fs. with any reasonable field excitation prevent a serious rush of current around the circuit through the two machines. Alternating-current synchronous machines cannot do this, owing to the physical necessity for each to run at the same number of cycles per second. It would seem at first sight as though this would prove a serious difficulty in the running of alternating-current synchronous motors or the running of synchronous generators in parallel, and would require the exact adjustment of the respective E. M. Fs. to certain values, such as to cause the proper exchange of currents. This, however, is not the case, the alternating-current machinery having the power to automatically readjust its own E. M. F. according to the demands made upon it. For example, if a synchronous motor with field excitation such as to give a counter E. M. F. of 1200 volts at normal speed is connected to a generator excited for only 1000 volts, there will be an exchange of wattless leading and lagging currents that will build up the field strength of the generator and pull down that of the motor until there is a proper exchange of mechanical power. The explanation of this happy feature of alternating-current machines is given in another column in an article entitled "Some Recent Developments in Alternating-Current Machinery." The action is so pronounced that it is frequently made use of for the total elimination of any direct-current field excitation, synchronous motors being sometimes run with no exciting windings whatever, the inductive action of the wattless currents being depended upon to induce proper field flux.

An interesting corollary of this action is the fact that a rotary transformer changing alternating into direct current gives a direct-current pressure proportional to the voltage applied to the alternating-current terminals regardless of the value of the field excitation, or, in fact, of the utter absence thereof. Such a machine if supplied through adjustable choke coils, or better, from stationary transformers with adjustable secondary voltage, such as are ordinarily known as auto-transformers, could by this simple means be made to give a ready variation of direct-current voltage from zero to the full pressure of the machine, giving an extremely convenient means of economically and simply varying the pressure for the control of motors or any other purpose. For long-distance traction or even for local heavy traction, the use on the vehicle of some such rotary as the Leblanc, in which the moving parts are very light, for transforming multiphase to direct current at any desired pressure could thus be made to give a system of great simplicity and flexibility.

The Great Northern Elevator.

BY ALBERT VICKERS.



ABOUT the middle of last spring ground was broken and the foundations were commenced for the largest and finest grain elevator ever planned. About the middle of last fall the house commenced to take in grain, and closed the season filled to the limit of its capacity.

This elevator, owned by the Great Northern Elevator Company, and called the Great Northern Elevator, is located in the southern part of the city of Buffalo, near the lake shore, on one of the branches of the Buffalo River. Not the least remarkable feature of the elevator was the rapidity with which it was constructed, enabling the company to use it during the present season.

The structure is entirely fireproof, being built wholly of steel and brick. The storehouse proper consists of thirty large tanks or bins, in three rows of ten each, each about 38 feet in diameter, and 70 feet high. They are constructed of boiler plate, bolted on the sides and double riveted on the bases, which are hemispherical in shape, and terminate in spouts about 11 feet from the floor. These tanks are supported on steel columns of the box girder type. There are also eighteen smaller tanks, constructed and supported

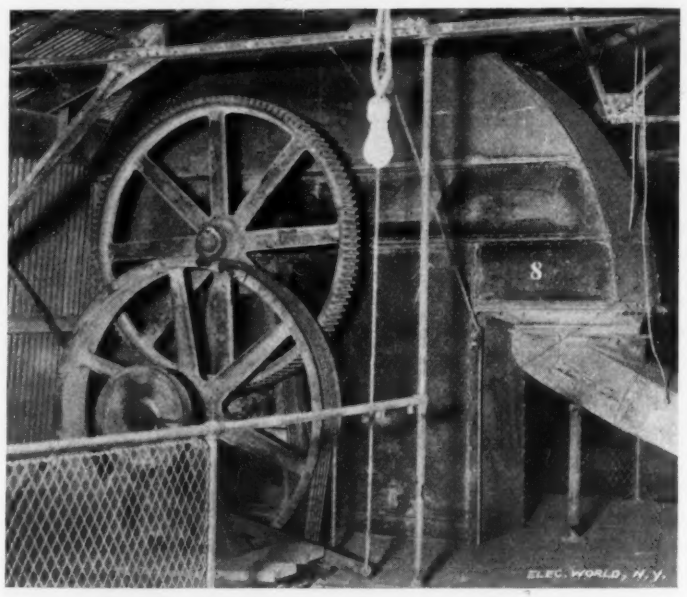


FIG. 2.—HEAD OF ROPE DRIVE AND REDUCING GEARS.

in a similar manner, 15 feet 6 inches in diameter, and 70 feet high. The large bins will hold about 80,000 bushels each, and the smaller about 18,000 each. The total capacity of the house is 3,000,000 bushels.

Across the top of the tanks are laid 6-inch I beams, upon which a steel floor is riveted, making what is called the distributing floor. Above this in the motor or scale floor, shown in Fig. 1. This floor and the floor above, which carries the leg-driving machinery, Fig. 2 are supported on columns resting on the top of the tanks, which also support the roof, leaving no weight on the brick walls, which merely act to seal the house up and protect it from the weather. Besides the main tanks there are two rows of shipping tanks, as follows: Eighteen shipping bins, four canal shippers, four wagon

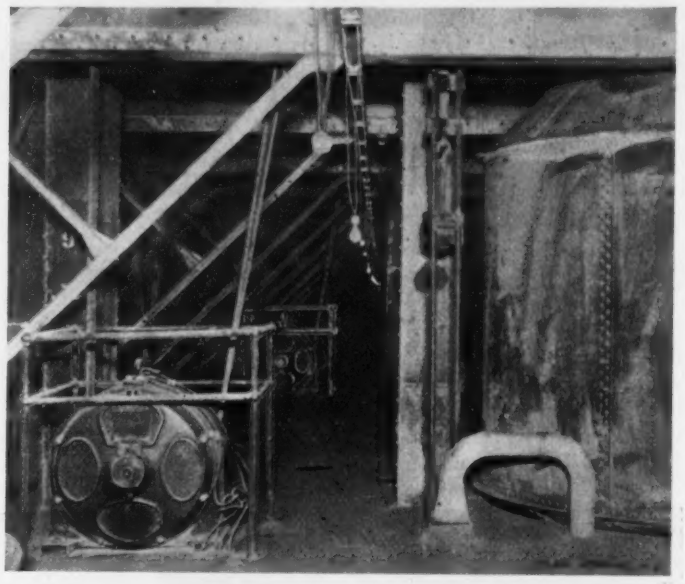


FIG. 1.—50-HP LEG-DRIVING MOTOR AND ROPE DRIVE.

shipping bins, besides scale garners and supplemental scale garners, between the walls and the tanks shown in Fig. 3, which gives a general plan of all the bins.

The total length of the building is 396 feet, and it is about 140 feet wide, and 170 feet high to peak of roof. It is approachable by water on two sides, and has a total of 590 feet of wharf room.

On the south side there is a dock 26 feet wide, carrying two tracks of 94-lb. T rail, bolted to 26-inch I beams, set on foundations of masonry every 10 feet. These tracks carry the three towers shown in the initial illustration. These towers carry the marine legs, which are lowered down into the ship's hold to scoop up the grain. They have a capacity of 20,000 bushels per hour each. They are movable up and down the tracks, being built on a base or truck, mounted on sixteen pairs of wheels of ordinary steam rail-

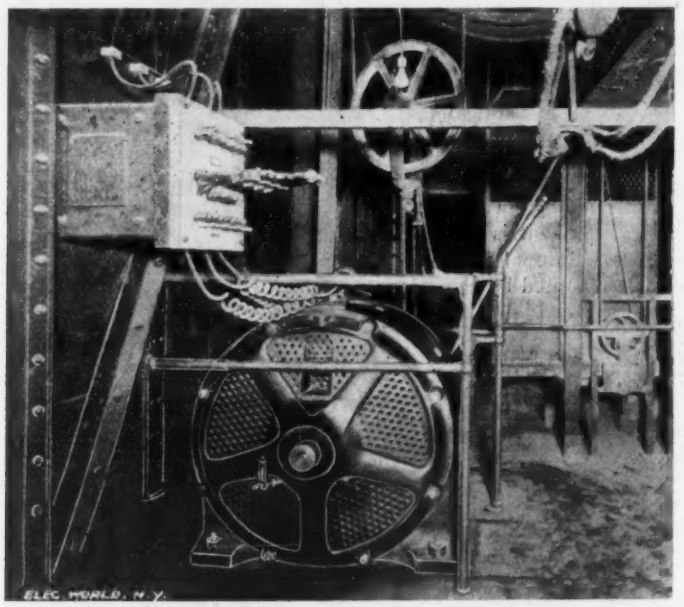


FIG. 5.—100-HP TOWER MOTOR.

road pattern. These towers lift the grain from the boats to the trough which runs the length of the house, where it is spouted down into the house, and again raised up by the belt conveyors of the inside legs, and distributed to the proper bins.

In Fig. 4, showing a section of the house, the location of these inside legs is shown, and their relation to the driving motors. This figure also shows the position of the tower motor seen in Fig. 7, and the location of the trolley wires and wires to both sets of motors.

Fairbanks scales are placed in each tower and at the head of

each inside leg, and at the several points of shipping out. In Fig. 3 the small sections marked "L," and numbered, show the location of the ten inside, or house, legs. These ten legs carry a double row of buckets, and turn up when running at the rate of 420 feet per minute. The pulleys at each end of the belt are 177 feet between centres. These legs are capable of handling 20,000

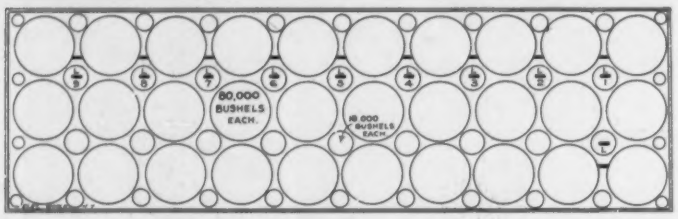


FIG. 3.

bushels of grain per hour. Each leg is run by a separate motor (see Fig. 1). These motors are connected to the driving gear by rope drives running in grooved sheaves, the velocity being still further reduced by means of gun metal pinions on sheave engaging with gear on leg shaft, shown in Fig. 2.

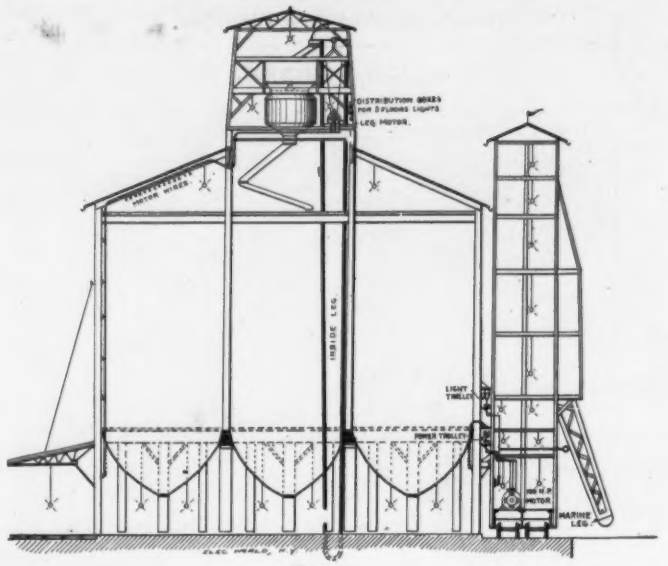


FIG. 4.

FIG. 6.—SWITCH ROOM.

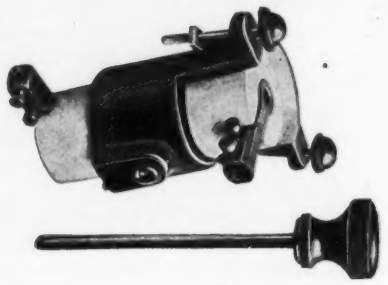


FIG. 19.—PRIMARY PLUNGER SWITCH.

This great house is interesting from the fact that it is the largest and finest elevator in the world, but its chief interest to electrical engineers is that it is the first elevator to be operated by electric power, an additional feature being that it is the first plant in Buffalo to be operated by the Niagara Falls power. The current is of course alternating, being received from the Falls cable at a pressure of 2200 volts, three phase, and reduced at the elevator to 440 volts, two phase. The reducing transformers, as shown in Fig. 6, at the end of the room, are of the tank type, of 500-kw capacity each, manufactured by the Westinghouse Company. The coils are covered with "mineral seal" oil, and each transformer is equipped with a wrought-iron water coil for cooling them.

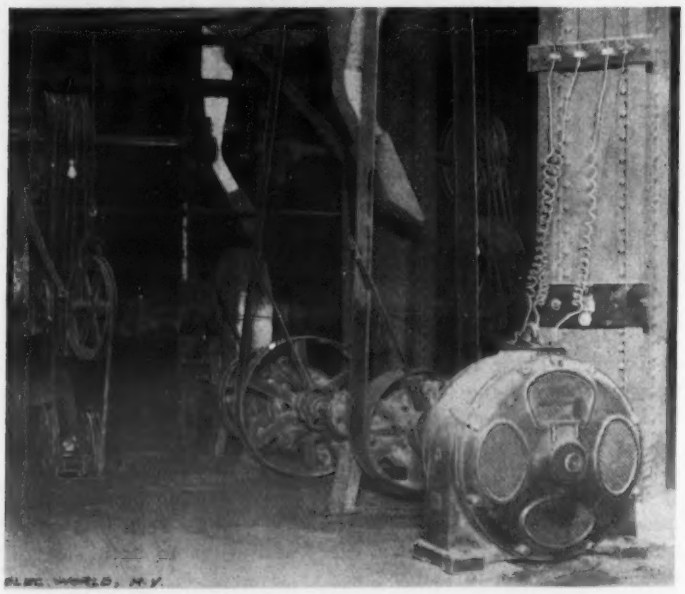


FIG. 8.—MOTOR FOR TOWER AND CAR HAULING MACHINERY.

The secondary current is carried to the bus bars back of the board by four 1,000,000-circular mil rubber-covered cables, supported by split porcelain cleats with iron clamps. These cables and construction are shown in Fig. 7.

The motors are all two phase, Westinghouse type C induction machines, there being eighteen in all throughout the building, aggregating 1000 horse-power. A 50-hp motor, shown in Fig. 8, runs the machinery for hauling the towers and cars, and a 10-hp motor runs the passenger elevator, shown with its accompanying machinery in Fig. 9.

The general distribution of the motors is shown in Fig. 10, which is an outline of a sectional elevation of the house, showing wiring and location of motors, in which a single line for simplicity is drawn for each set of three wires running to each motor.

The motor switchboard consists of nine white marble panels, shown in Figs. 6 and 11, each panel carrying two switches, starting coils and connections for two motors. The switches are what is known as the washer type, with quick break trigger attachments, and are four-pole double throw. Each motor is provided at the switchboard with a pair of inductive coils, by which the two circuits can be supplied with a lower voltage on the lower position of the switch (see Fig. 12). The switch is thrown in this position for starting and held until motor is up to speed, when it is thrown into the up posi-

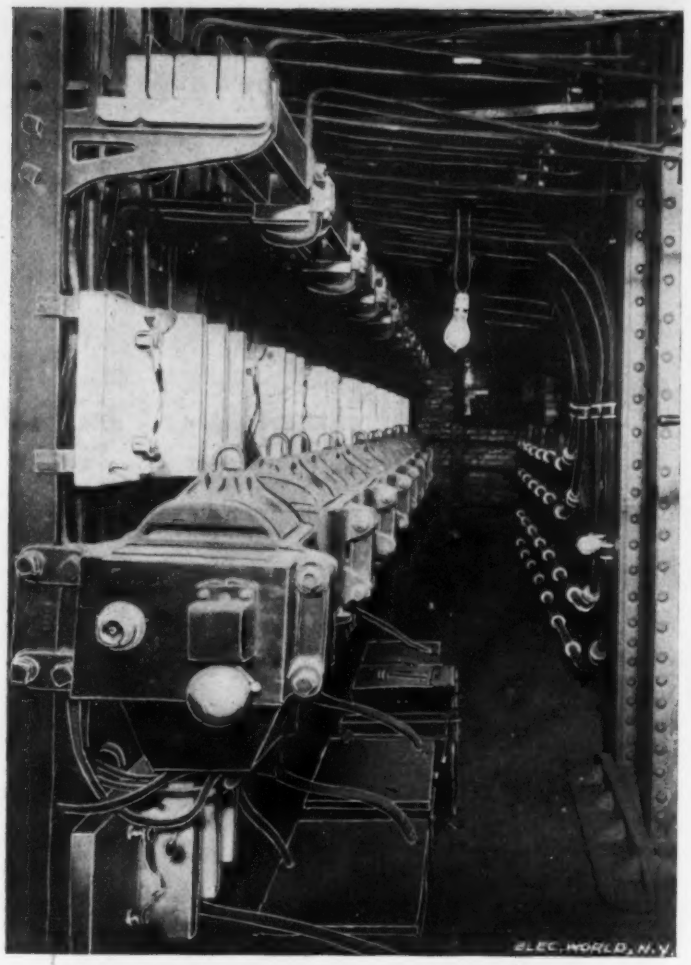


FIG. 7.—BACK OF SWITCHBOARD.

tion. There are three degrees of starting torque provided for in the starting coils. It was found by experiment that the medium torque was best for all motors up to 50 horse-power, and the maximum torque for the 100-hp motors. A novel feature of these switches is the spring bracket, which supports the switch in a horizontal position when not in use, preventing any possibility of accidental starting. These brackets fly back automatically when the switch is raised. The switches are massive and reliable and have given excellent satisfaction, handling heavy currents with a minimum spark. All the motors in the house are controlled from the electrical room, except the three tower motors, which have switch and starting coils at motor, as shown in Fig. 5. This confines sparking, with this exception, entirely to the switch room, which is an item of much importance in grain elevator work. The back of the board carries the

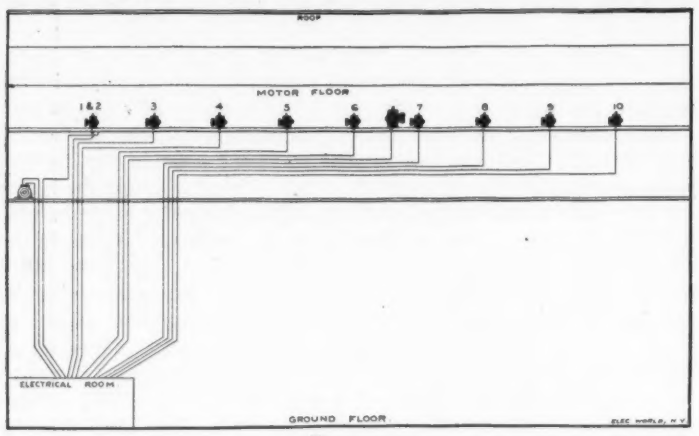


FIG. 10.

starting converters already mentioned, the bus bars and the fuse blocks, which are shown in Fig. 7. These blocks are of white marble, partition type, and aluminum fuses are used entirely, these giving greater accuracy and entire freedom from smoke and blackening of marble when blown.

From the fuse blocks throughout the house the three-wire system is used, and the line loss is calculated for 5 per cent. drop for all circuits. All wire in the building is rubber covered, including the bell and telephone leads, and all wires over No. 8 are stranded flexible cable.

Fig. 13, which is a view of the leads as they leave the roof of switch room, shows a fair idea of the style of construction used throughout. As the building is entirely of iron, great care was necessary to prevent any possibility of grounds, or short circuits. In general, all suspensions are made on split porcelain single-wire cleats, up to size

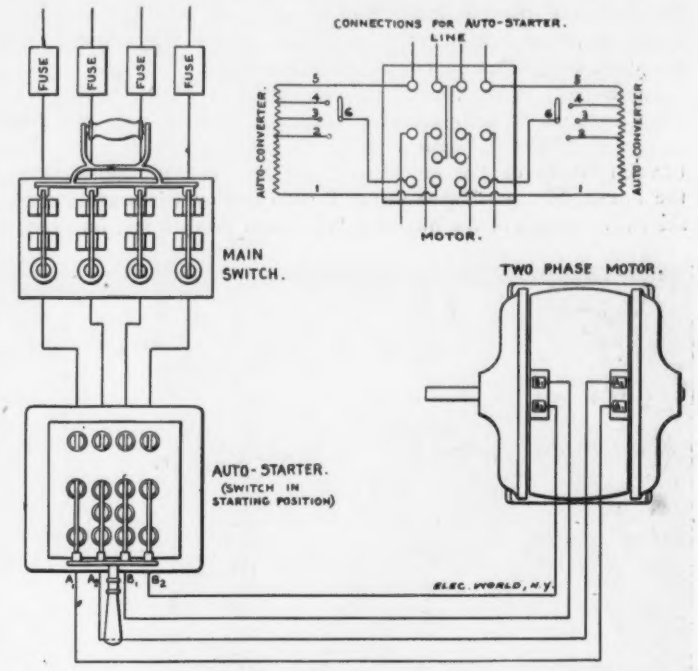


FIG. 12.

No. 1, above which sizes iron clamps with insulated bushings are used. These insulators are screwed to hard pine cleats, which are lagged to the brick wall and fastened to iron work by means of hook bolts. In fastening to walls, holes 1¼ inches x 8 inches deep were drilled in the brick 21 inches apart and solidly plugged with a tarred plug, and the five-eighths inch x 8 inch lag screws were used to bolt on the cleats. This has proved a very solid construction. The cleats are of 2 inch x 6 inch pine, and all wires are maintained at a uniform distance apart of 7 inches. The cleats and supports are

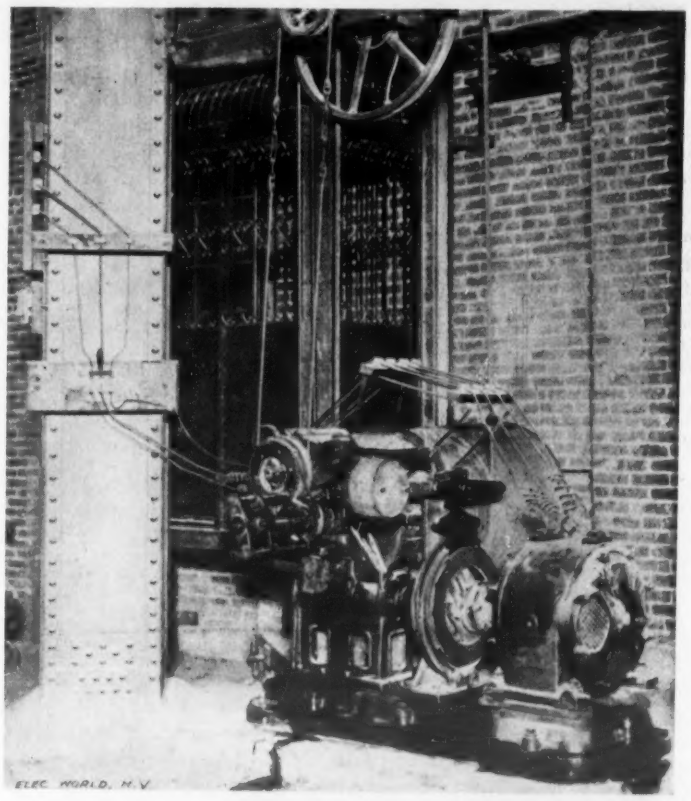


FIG. 9.—PASSENGER ELEVATOR MACHINE.

at an average distance apart of 6 feet, and double insulators are put on at every turn and strain, preventing any possibility of falling wires. Where wires pass through the sheet iron floors and partitions special pains have been taken to prevent them from ever coming in contact with the sharp edges, which would very soon cut the rubber cover if a tube were broken. Instead of merely using tubes where the wires pass through the sheet, a wide slot is cut about 2½ inches wide, and long enough to accommodate the whole number of wires, and a hard-wood block carrying heavy porcelain bushings, set flush with the wood, is inserted in the slot and screwed fast in place. These bushings cannot easily be broken, and if they should be the wires can only come in contact with the wood.

The motors in the towers are controlled as stated above by separate switches at each motor. They are supplied with current by means of trolleys and trolley wire. This trolley system is one of the novel features of the house, and can be seen in the section of the house, Fig. 4. Three figure 8 0000 trolley wires are stretched the entire length of the building, supported every 6 feet on brackets,

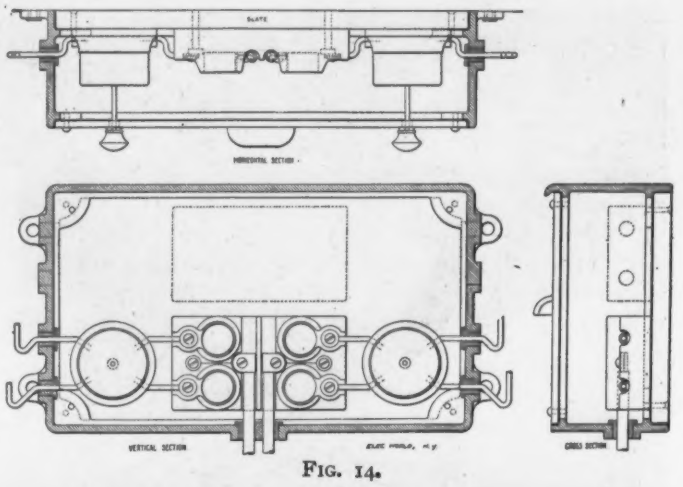


Fig. 14.

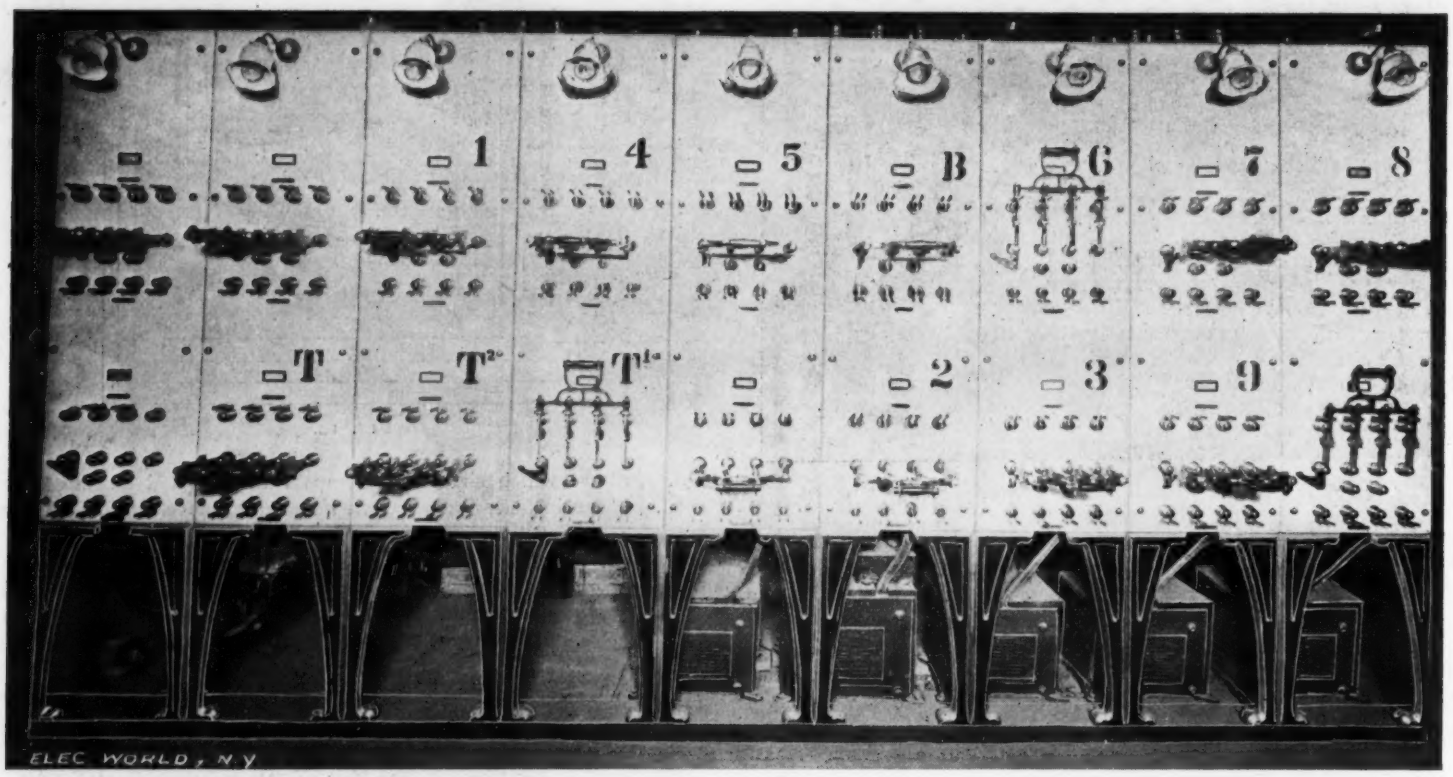


Fig. 11.—Front of Main Switchboard.

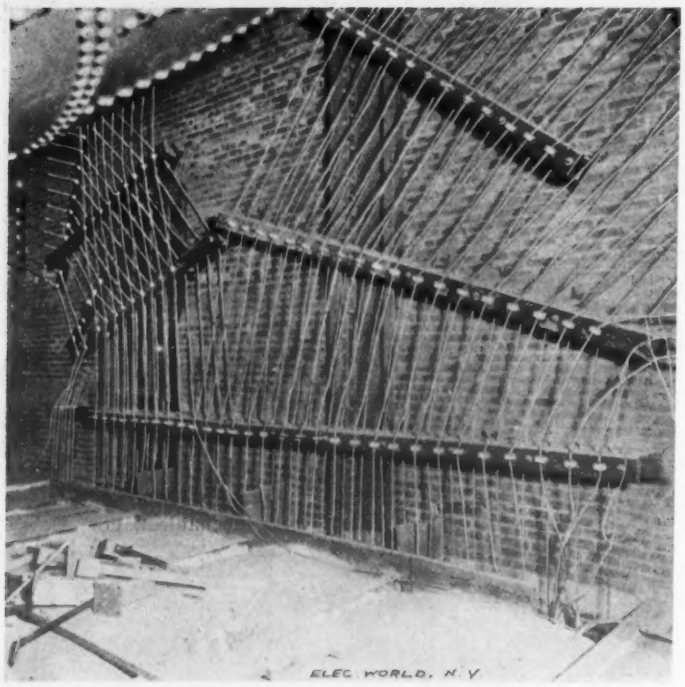


Fig. 13.—Feeders Running from Switch Room.

and separated 5 inches from each other. The insulators are cap and cone hard rubber insulation, barn hanger type, with Lieb clamp ears, bolted to a hard pine bracket, 4 inches x 4 inches, dovetailed into the brick walls and supported by a 2-inch angle iron brace, lagged into a plugged hole with an 8-inch lag bolt. These trolley wires are fed from the switch room by three separate circuits of No. 1, No. 0 and No. 00 wire tapped in at three different points.

The towers are fitted with three U. S. Standard trolley bases, carrying three 5-foot trolley poles. The trolleys are set in line and the poles are offset for the two outside wires. To provide for the heavy current used a shoe 6 inches long is used in place of a trolley wheel. This trolley system enables the towers to be moved through the whole length of the dock, keeping their electrical connection at all points. They have worked so far with perfect smoothness and satisfaction. There is a similar construction for the lighting circuits of the towers, two No. 0 wires being used, with supporting brackets 18 feet apart. Wires are run from these two trolleys on each tower to junction boxes, thence distributed through the towers. All the power apparatus, switchboards, motors, etc., were furnished by the Westinghouse Electric and Manufacturing Company.

The alternating-current motor, although developed and perfected later than the direct-current motor, was found to possess such great practical advantages, that it has by rapid strides largely supplanted the latter in mny important applications. The two-phase, type "C" induction motors used in this work are extremely simple in construction and operation. This type of motor has two elements, the primary, which is stationary, and the secondary, which is the revolving element. The primary is shown in Fig. 18, and the

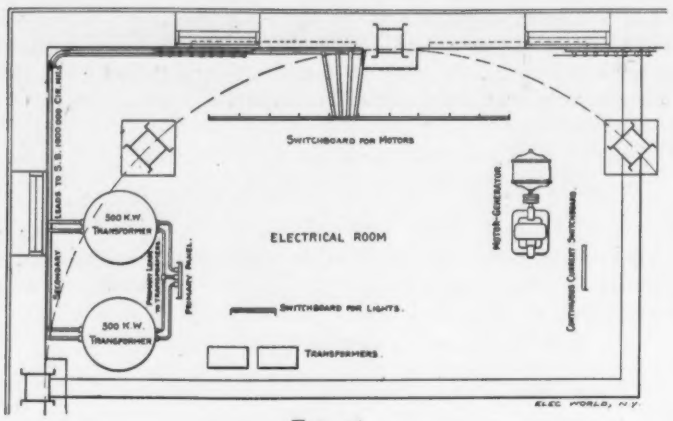


FIG. 16.

FIG. 17.—STATIONARY PRIMARY OF MOTOR.

secondary in Fig. 19. There is no moving wire nor sliding contacts in the motors. Their work is giving perfect satisfaction.

The primary switchboard, consisting of a single panel of white marble, may be seen at the far end of the electrical room (Fig. 6). It is very simple and efficient.

Special notice is due the main switches, shown at the three knobs in the centre of the board and in Fig. 19. These switches are what are called plunger switches. They break the circuit quickly and the break is made in a small enclosed air chamber of heavy porcelain back of the board, thereby limiting the expansion creating a strong lateral draft of air through a vent provided for that purpose, thus cutting off any tendency to arc. As a matter of fact, with transformer load of about 13 horse-power it is impossible to perceive any arc whatever when the plugs are withdrawn.

The lights in the building number 420, of which 150 are 32 candle-power and the rest 16 candle-power. They are supplied by two transformers, from 2200 volts three phase to 104 volts two phase.

The main transformer is of 17.5-kw capacity and the smaller or "teazer" of 15-kw capacity. There are four pairs of main feeders in all. Two pairs run the length of the house on the ground floor and tap into the distribution boxes, which are dust proof (see Fig.14). These boxes were specially designed for this plant by the engineers. They consist of cast iron boxes with dust proof lids, and contain two Edison plug cut-out branch blocks and four double-pole Bryant snap switches.

The other set of feeders feed the distribution boxes on the upper floors, Fig. 15 shows a diagram of distribution on thte motor floor, and Fig. 4 shows the location of these boxes. These control the circuits for the floor above and main floor below, as well as the floor they are on. The main lighting switchboard is shown in Fig. 6 to the left. The passenger elevator, shown in Fig. 9, is operated by a two-phase Westinghouse type C 10-hp motor, and is controlled by a rotary switch operated by cable from the car. It was built and installed by the Howard Iron Works of Buffalo. This motor is specially constructed to start on full voltage without starting coils.

The value of electric power for mill work in general has been recognized for a long time, and no form of mill work seems to the writer to actually need the benefits to be derived from it more than grain elevator work. Elevators, by the nature of their work, require machinery to be driven at great heights from the ground and in many widely separate parts of a necessarily large building. It is impossible to concentrate the machinery, and in case of moving towers, with which most houses are equipped, a flexible transmission is required. Where this machinery is driven mechanically, as in almost all elevators, long drives of belts and ropes are necessary. Complicated shaftings and turns are needed, and in addition to the great loss in friction the oil waste, trouble and repair items are considerable.

The author considers the alternating motor, because of its freedom from the possibility of sparking, to be the best that can be selected for elevator work. As in the present case, the motor can be placed directly at the point where power is wanted, all transmission machinery is done away with, and the mechanical efficiency is brought to a maximum.

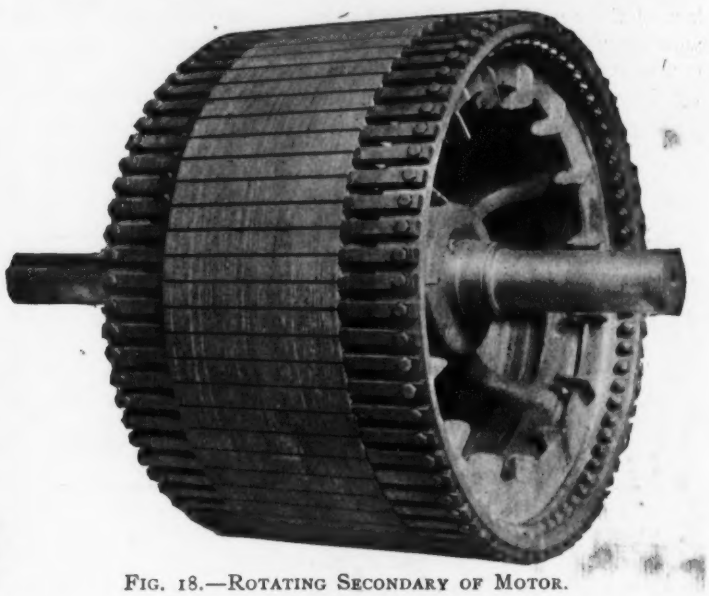


FIG. 18.—ROTATING SECONDARY OF MOTOR.

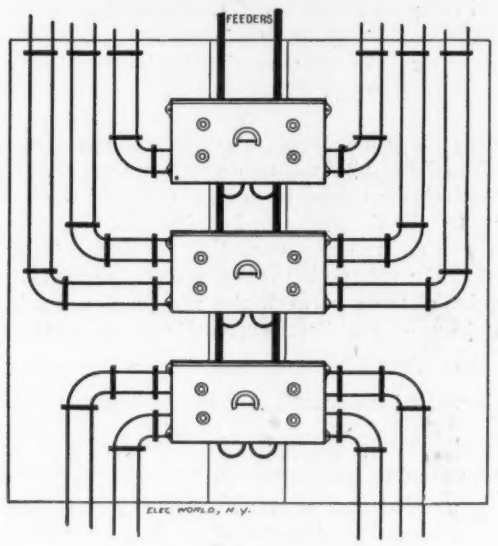


FIG. 15.

After the success which this house is showing, and the absence of any trouble whatever in its operation, elevators generally will probably fall into line, and as they have opportunity equip with electricity. The building was erected under the direction and supervision of Mr. D. A. Robinson, of Minneapolis, after suggestions made by President James J. Hill. The electrical engineers were Messrs. Carlton and Meadows, of Buffalo, N. Y.

Some Laws of Rotary Transformers—II.*

BY J. E. WOODBRIDGE AND CHARLES T. CHILD.

II.—THE TWO-PHASE ROTARY.

THE conditions obtaining in the two-phase rotary transformer are widely different from those which have been discussed in connection with the single-phase machine. As the circuits of the alternating currents in the armature overlap, the alternating current in the armature windings is the resultant of a combination of two equal currents 90° apart in phase. The four leads from the four collector rings divide the armature into four equal quadrants, and the current coming in though any one lead divides and flows equally though the two halves of the armature to the lead diametrically opposite. It is evident from an inspection of Fig. 4 that the alternating current in any one of these quadrants is (assuming unity power-factor) the combination of two equal currents respectively in phase with the projections of the two sides of the quadrant on the line of commutation, and its phase relation may therefore be represented by the projection of a line from the axis of rotation through the middle point of the quadrant upon the line joining the two brushes. Thus, in the figure, where P is the middle point of the quadrant $N\ Y$, the alternating current in this quadrant may be vectorially represented by the projection of a radius through P upon the line $A\ B$, since it is the resultant of two equal currents vectorially represented respectively by the projections of $O\ Y$ and $O\ N$.

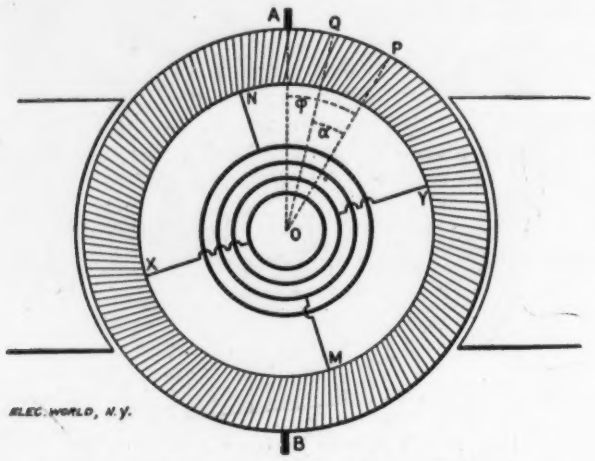


FIG. 4.—DIAGRAM OF TWO-PHASE ROTARY.

Referring to the diagram, and using the notation hitherto adopted, in which C represents one-half the direct current through the brushes, V the voltage between the direct current brushes, and φ the angular distance between the middle of a quadrant of the armature and one of the direct current brushes, then:

V = maximum instantaneous alternating voltage, and

$\frac{V}{\sqrt{2}}$ = virtual alternating voltage between diametrically opposed collector rings. Then

$\frac{C}{\sqrt{2}}$ = virtual alternating current in either phase (assuming a power-factor of unity), since the total energy of the alternating side is equal to that of the direct-current side, consequently the product of the virtual alternating current and voltage in one phase must be equal to one-half of $C\ V$, the product of the direct current and voltage;

C = maximum instantaneous alternating current in one phase; and

$C\sqrt{2}$ = maximum instantaneous combined alternating current in the armature winding, since the two components differ from each other in phase by one-quarter period.

Let α be the angular distance between any conductor on the active surface of the armature, such as Q, and the point P, and let r be its resistance. The direct current in it will be C; the alternating current at the instant represented will be $\sqrt{2}\ C \sin \varphi$. The resultant of these two currents will be

$$C - \sqrt{2}\ C \sin \varphi \quad \ldots\ldots(7)$$

The rate of heating at the instant represented will be

$$\left\{C - \sqrt{2}\ C \sin \varphi\right\}^2 r = C^2 r \left\{1 - 2\sqrt{2} \sin \varphi + 2 \sin^2 \varphi\right\}$$

To find the total heating effect during one-half a rotation (the effect obviously being symmetrically and exactly repeated at every such period) this expression must be integrated:

$$C^2 r \int \left\{1 - 2\sqrt{2} \sin \varphi + 2 \sin^2 \varphi\right\} d\varphi =$$

$$C^2 r \left\{2\varphi + 2\sqrt{2} \cos \varphi - \frac{\sin 2\varphi}{2}\right\}$$

This only holds good while the point Q is moving from one brush to the other. We may, therefore, apply the limits $\varphi = \alpha$ and $\varphi = \pi + \alpha$. When $\varphi = \pi + \alpha$ the expression becomes:

$$C^2 r \left(2\pi + 2\alpha - 2\sqrt{2} \cos \alpha - \frac{\sin 2\alpha}{2}\right),$$

and when $\varphi = \alpha$

$$C^2 r \left(2\alpha + 2\sqrt{2} \cos \alpha - \frac{\sin 2\alpha}{2}\right).$$

Subtracting the second expression from the first gives the value of the total heating effect in the conductor while it is traversing an arc equal to the difference between the two limits. Hence, to find the rate of heating this difference may be divided by π which gives

$$C^2 r \left(2 - \frac{4\sqrt{2}}{\pi} \cos \alpha\right).$$

As $C^2 r$ is the heating effect when generating direct current, dividing by $C^2 r$ gives, as the ratio of the heating effect in the section under consideration to the heating if the machine was generating the same load as a direct-current dynamo,

$$2 - \frac{4\sqrt{2}}{\pi} \cos \alpha \quad \ldots\ldots(8)$$

Evidently the distribution of heat is not uniform in the different coils of the armature, as is the case when generating either direct or alternating current, but depends upon the position of the coil relative to the points at which the collector rings are connected with the windings. This variation is shown in the accompanying curve, Fig. 5, in which the angular distance of a coil from one collector ring lead is plotted horizontally and the heat generated in it is plotted vertically. It may be seen from this that the windings immediately adjacent to the collector ring connections in the case under consideration, with the power-factor unity, suffer a heating effect nearly four times as great as those midway between the points of introduction of the alternating current. This, of course, assumes that all the parts of the winding are of the same gauge.

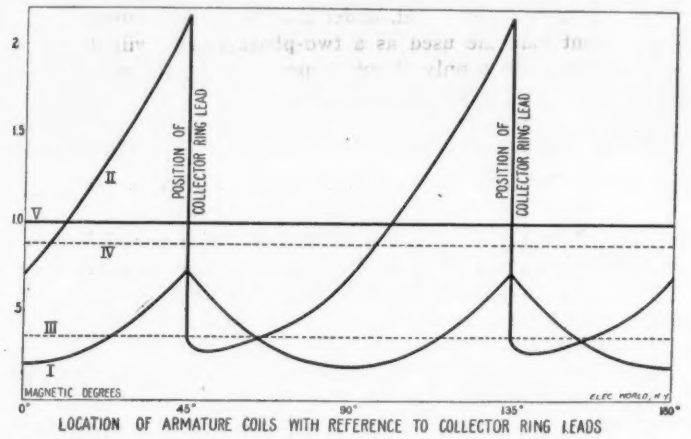


FIG. 5.—DISTRIBUTION OF HEATING AROUND THE ARMATURE.

I.—Power Factor Unity.
II.—Power Factor, 80 per cent.
III.—Average Ordinate of Curve I.
IV.—Average Ordinate of Curve II.
V.—Heating with Machine Driven as Direct or Alternating Current Dynamo.

Since the expression (8) gives the value of the heating effect in the rotary coils in terms of that produced in the same coils when the machine is driven by mechanical means as a direct-current generator with the same output, the heavy horizontal line, with an ordi-

*Continued from THE ELECTRICAL WORLD of January 1, 1898.

nate unity, in Fig. 5, shows the heating effect in the coils under the latter consideration. It may be seen that the coils midway between the leads suffer only one-fifth the heating effect produced in them when the machine is working as a direct-current generator, while those immediately adjacent to the leads suffer seven-tenths as much.

This value of the heating effect was based upon the assumption of unity power factor. If, however, the field excitation is such as to create of itself a back E. M. F. of unsuitable ratio to the impressed E. M. F. the effect will be quite different, as wattless currents will flow in the armature and increase the heating effect. By introducing in the expression (7) above, the proper changes for an angle of lag or lead of the alternating current, β the expression (8) becomes

$$2 - \frac{4\sqrt{2}}{\pi}\cos\alpha + \tan^2\beta + \frac{4\sqrt{2}}{\pi}\tan\beta\sin\alpha \ldots\ldots(9)^*$$

The representation of this expression for a typical value of β is interesting and is shown as curve II. of Fig. 5, the angle of displacement being 37°, corresponding to a power factor of 80 per cent. Here the symmetry of the heat distribution about the line of collector ring connections is lost, as was the case with the single-phase machine, but there are in the two-phase armature twice as many maxima and minima, so that the effect is much more readily equalized by thermal conductivity. The maximum heating is now over twice that of the same coils generating direct current, and the minimum (no longer at the middle of the section) is about one-quarter the direct-current effect.

The most important consideration in the rating of these machines is the average heating loss in their armatures, which, for equally cool running, must be limited to that of the maximum current of the same machine used as a dynamo. The average heating effect may be best obtained by integrating (8), considering α, the angle between the element under consideration and the middle of the coil, to vary through the quadrant between the two leads.

$$\int\left(2 - \frac{4\sqrt{2}}{\pi}\cos\alpha\right)d\alpha = \left(2\alpha - \frac{4\sqrt{2}}{\pi}\sin\alpha\right)$$

Applying the limits $\alpha = \frac{\pi}{4}$ and $\alpha = -\frac{\pi}{4}$ the expression evaluates as $\left(2\pi - \frac{16}{\pi}\right)$ which, divided by the difference π between the limits, gives

$$2 - \frac{16}{\pi^2} = 0.38\ldots\ldots(10)$$

Thus, it may be seen that, under the conditions assumed, any direct-current machine used as a two-phase rotary will dissipate as $C^2 R$ armature loss only about 38 per cent. of the energy wasted when working as a generator at the same output. To determine, therefore, the safe load of a machine with a known generating capacity when worked as a two-phase rotary, let K be this safe transforming current capacity; then

$$0.38\, K^2 r = C^2 r$$

from which $K = 1.62\, C$.

Hence, with unity power factor, the rating of a two-phase rotary transformer may be 62 per cent. greater than that of a direct-current generator or motor of the same dimensions. This however, assumes that the current and E. M. F. on the alternating side are in phase with each other, and that both are sinusoidal. By integrating** the expression (9) it may be shown that with an angle of displacement β the ratio of the total losses becomes

$$2 - \frac{16}{\pi^2} + \tan^2\beta \ldots\ldots\ldots\ldots\ldots\ldots,(11)$$

Assuming, as before, a power factor of 80 per cent., corresponding to an angle of displacement, either leading or lagging, of about 37°, this value becomes 0.98. In other words, the transforming capacity is reduced to about $\frac{1}{\sqrt{0.98}}$ or about the same as the generating capacity.

This figure, however, makes no allowance for the unequal distribution of the heat generation, the effect of which depends, of course, on the thermal conducting qualities of the armature. In view of this fact the transforming capacity of a two-phase rotary can hardly be safely estimated at much over its generating capacity, unless its power-factor is closely maintained near unity.

A highly interesting corollary of this discussion is the fact that the same machine wastes the same energy when used as a two-phase alternating-current generator or motor as when working as a direct-current machine, instead of twice as much as does the single-phase machine. This is due to the fact that the internal virtual alternating current corresponding to a direct current C is equal to C. The generation of this heat is, of course, uniformly distributed throughout the armature, but in case of the alternating current it varies with the time. Another interesting point is the variation of the heat waste with the angular position of the armature of the machine, used as a rotary. This is shown in Fig. 6. The equation of this curve in terms of the generating loss, for the general case of displaced currents, can be shown to be:

$$\text{Ratio} = \left\{ 2 + \tan^2\beta - \frac{4\varphi\sqrt{2}\sin(\varphi+\beta)}{\pi\cos\beta} - \frac{\sqrt{2}\cos(\varphi+\beta)}{\cos\beta}\right\}\ldots 12)$$

When this is integrated between proper limits it, of course, gives the value already deduced in expression (11).

When the power factor is unity (12) reduces to the form:

$$\text{Ratio} = 2 - \frac{4\sqrt{2}\,\varphi\sin\varphi}{\pi} - \sqrt{2}\cos\varphi$$

The curve of Fig. 6 is plotted from this latter value.

A consideration of the physical combination of the currents in the armature of the two-phase rotary shows that when two diametrically opposite collector ring leads are immediately under the brushes, the other pair being in a polar line, the instantaneous value of the alternating current entering through the latter pair is zero, while that of the former pair is at its maximum, or, as pointed out above, exactly equal, in the case of unity power factor, to the direct current. Thus in this case the alternating current coming in through the collector rings exactly balances the direct current passing out through the brushes, and can, therefore, be considered to feed it directly, the resultant current in the coils being at this instant zero. This occurs four times per revolution and causes the curve of the heating effect, shown in Fig. 6, to drop to the zero line at these four instants. The maximum instantaneous heating effect occurs midway between these zero points, that is, when the commutator brushes are on the middle segments of two quadrants. At this instant the evolution of heat in the armature is a maximum and is equal to about 0.6 of that evolved by the generation of the same direct current from mechanical power.

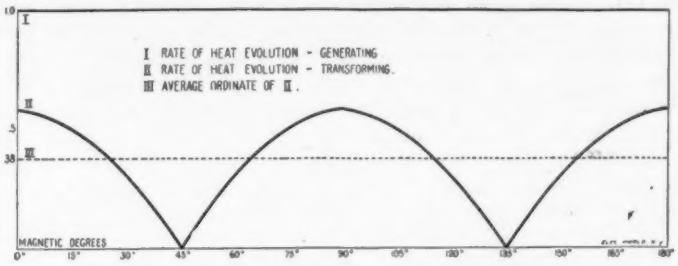

I RATE OF HEAT EVOLUTION - GENERATING
II RATE OF HEAT EVOLUTION - TRANSFORMING.
III AVERAGE ORDINATE OF II.
MAGNETIC DEGREES

FIG. 6.—TIME VARIATION OF HEATING.

The reaction and distortion of the armature of the two-phase rotary is notably different from that of the single-phase machine. In case of unity power factor there is no field reaction, provided the direct current brushes are placed midway between the pole tips. The armature reaction, using this term to signify the component of the armature magnetization which tends to increase or diminish that of the field, is solely dependent upon the wattless leading or lagging currents, as is the case in any synchronous alternating machine. There is also, of course, no resultant field distortion with any power factor, as a resultant distortion in either direction implies a mechanical pull on the armature, which is impossible in the case of a machine used purely as a transformer. As was pointed out in the first installment of this paper, the single-phase rotary possesses an alter-

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* Expression (7), with currents out of phase with the back E.M.F., by an angle β, becomes $\left\{ C - \frac{\sqrt{2}C}{\cos\beta}\sin(\varphi+\beta)\right\}$

Squaring, multiplying by r, expanding and integrating this with regard to φ, applying the limits α and $\pi + \alpha$, and dividing by π gives the expression (9).

** $\int(2 - \frac{4\sqrt{2}}{\pi}\cos\alpha + \tan^2\beta + \frac{4\sqrt{2}}{\pi}\tan\beta\sin\alpha)\,d\alpha =$

$$2\alpha + \alpha\tan^2\beta - \frac{4\sqrt{2}}{\pi}\sin\alpha - \frac{4\sqrt{2}}{\pi}\tan\beta\cos\alpha.$$

Applying the limits $\frac{\pi}{4}$ and $-\frac{\pi}{4}$, subtracting and dividing by $\frac{\pi}{2}$ gives $2 - \frac{16}{\pi^2} + \tan^2\beta$.

nating field distortion of very considerable amount with twice the frequency of the alternating supply, tending to produce Foucault currents in the pole pieces and oscillate the plane of commutation. The two-phase rotary has no such alternating distortion, the resultant distorting effect at any and all instants being zero. This can be shown by an equation expressing the instantaneous variation of the resultant distorting effect, but is also obvious from the consideration of the absorption of power in any two-phase motor. The power absorbed in one circuit varies from instant to instant as the square of the sine of the angle of rotation, and in the other circuit as the square of the cosine of the same angle. The sum of these two is obviously a constant independent of the instantaneous position of the armature, hence the rate of absorption of power from the alternating system is constant. The rate of supply of power to the direct current system is also constant, hence there is no resultant field distortion at any instant and no fly-wheel effect as in the single-phase machine.

On the other hand there is obviously a revolving polarity of variable strength carried around by the armature. At the points on the windings where the four collector rings are tapped in magnetic poles are created by the currents entering through the leads and dividing to pass around the two halves of the armature. The strength of these four poles rises and falls in synchronism with the alternating current supply, while they are rotating past the pole faces. On this account the latter should be laminated, as they customarily are in alternating current machines, the action in the rotary being the same as in a synchronous alternating dynamo with the same phase arrangement of circuits.

The consideration of such a machine as a mechanically driven double-ended generator is interesting, the use of such a machine having often been proposed for the supply of lighting systems, taking low voltage direct current from the commutator for the district near the central station, and multiphase alternating currents from the collector rings for transformation and transmission to the outlying districts. The determination of the internal losses with this combination of the currents is closely similar to that given above, the only change being the addition of the second term to the first in equation (7), instead of its subtraction. The work carried through with this change shows that in a machine generating one-half its rated kilowatts as direct current and the other half as alternating two-phase current with unity power factor, the $C^2 R$ loss is 10 per cent. less than if the whole power were generated on either side. With lagging power the aggregate loss would be brought up practically to that of the direct-current machine, so that any machine so used has practically the same capacity as when used as a single-ended generator, either direct or two-phase alternating.

Japanese Patent Law.

In the treaty entered into March 11, 1897, between Japan and the United States of America, were provisions for the protection by patents in either country of the inventions of citizens of the other. The Japanese patents are granted for any one of three terms, namely, five, ten or fifteen years, reckoned from the date of registration, these terms not being alterable after the patent has been granted. Designers of improvements on patented inventions are required to obtain a license from the patentee of the original invention before applying for a patent upon the improvement. If this license to use the original invention cannot be obtained, the Minister of State may grant the patent, fixing the compensation to be paid to the original patentee. No annuities are required, but patents shall be forfeited when the patentee, without sufficient reason, has not exploited his invention within three years of the date of his patent, or discontinues working the invention for three years at any time, or when the patentee imports and sells an article for which he has obtained a patent or acquiesces in the selling of an article which infringes his rights. Infringers of patent rights are liable for damages to the patentee, the term of liability being three years.

The Majority of the Telephone Industry.

The date of issue of this paper, February 12, is the twenty-first anniversary of the transmission of the first newspaper despatch sent over the telephone. The communication was sent to the Boston *Globe* from Salem, where Professor Bell was lecturing before the Essex Institute.

Some Recent Developments in Alternating Current Regulation.

Some excellent illustrations of the beautiful flexibility and ease of regulation of alternating currents are afforded by two patents recently issued.

One of these bears the No. 596,186, and date of issue December 28, 1897, the patentees being Messrs. Charles P. Steinmetz and Edwin W. Rice. The device described is called a phase regulator, and consists of an arrangement for obtaining by the use of induction machines a leading current to compensate on any alternating system for the lagging of any other apparatus which may be connected thereto. It is well known that condensers may be and are used for this purpose, but their use is subject to several objections, chief of which is the liability of capacity in combination with self-induction becoming tuned or synchronized to some of the upper partials of the E. M. F. waves, and thereby reinforcing these enormously, to the general demoralization of the system. Synchronized motors with excited fields are capable of the same use, as by over-exciting the magnetic circuit the motor may be made to take leading currents, or by under exciting the fields to take lagging currents. Their chief objection is the necessity of a source of direct current of some sort for the field excitation.

In the arrangement described in this patent, and shown diagrammatically in Fig. 1, *A* represents an ordinary induction motor of the simplest type, with short-circuited secondary windings on the internally mounted motor. This machine drives machine *B*, preferably at a speed above synchronism, the connection between them being indicated as a belt arranged for the proper ratio of revolutions

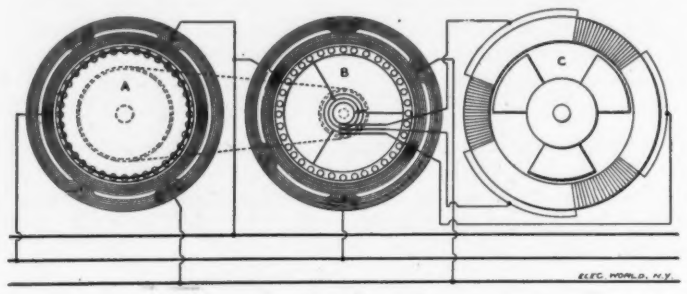


Fig. 1.

per minute. Machine *B* is also an induction machine, with an external fixed primary and an internal revolving secondary, wound, however, with open coils connected to slip rings from which the induced currents can be led off and controlled in machine *C*. This is simply a diagrammatic representation of another device for varying the self-induction of the three coils wound thereon without changing their resistance, the internal rotative iron segments being arranged to close or open the magnetic circuits around the three windings on the fixed part. This is intended to be arranged for hand manipulation by means of some such arrangement as a worm and worm wheel.

The whole system is based upon the principle that inductive circuits, such as those represented in *C*, when inductively connected, as shown, cause lagging currents to pass in the line circuits as long as the secondary of machine *B* runs below synchronism, but cause leading currents when the speed is run above synchronism. In this way, by properly adjusting the self-induction of coils *C*, a suitable leading wattless current can be superposed on the other currents passing through the line system, and made useful in increasing the power factor of the generating and transmission system to unity, and thereby eliminating the serious reactive fall of potential in both generator and line systems caused by the lagging currents. Machine *A* may, of course, be an induction or synchronous motor or any other available source of power. The device is just as suitable also for single-phase as for multiphase systems.

In practical application, machines *A* and *B* would be preferably direct coupled, the number of poles on the two machines being different in order to obtain the proper difference between synchronous speeds. The windings of both machines, preferably of the same size, could be brought out on collector rings, when by short circuiting the windings of the machine of fewer poles, and connecting the inductive circuits to the brushes of the other, leading currents could be introduced into the system; or, by short circuiting the slower machine and rendering the secondary of the other induc-

tive, lagging currents could be introduced if the occasion for them should arise.

The other patent is No. 595,412, issued December 14, 1897, to Edwin W. Rice, Jr., and is entitled "Regulating Alternating Current Dynamo Electric Machines." The devices described depend upon the peculiar reactive effect of wattless alternating currents on the field magnetization of synchronous machines, and for the benefit of those not well acquainted with this principle a brief explanation of it will be given. In Fig. 2 there is a diagrammatic representation of a two-pole machine, with a rotating armature fitted with two collector rings. The tendency of the field magnets is to maintain a flux of magnetic lines horizontally across this armature, while the flow of alternating currents in the armature through the collecting rings tends to change this magnetic condition. Assuming first that the machine is working as a dynamo generating alternating currents on a non-inductive load, the armature currents will tend to set up an alternating magnetization of the armature core with poles at the points at which the collector ring leads are attached to the winding. The load being non-inductive the armature magnetization will reach its maximum value at the instant when the collector ring leads are in a vertical line. This will give at that instant a field distortion similar to that in direct current machines with the brushes midway between the pole tips. The resultant horizontal effect of the armature magnetization will be zero. If, however, the current lags, due to an inductive load, it will reach its maximum value later when the collector ring leads have moved around to a position inclined somewhat to the vertical, and will tend in that case to set up a horizontal component of the magnetization opposed to that of the field magnets. On the other hand, if

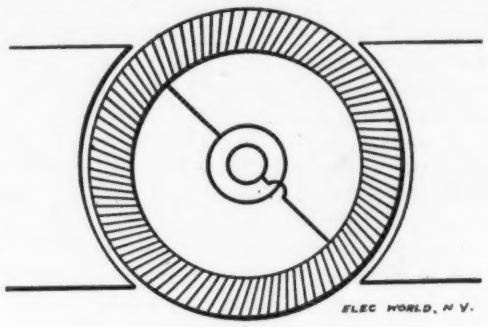


FIG. 2.

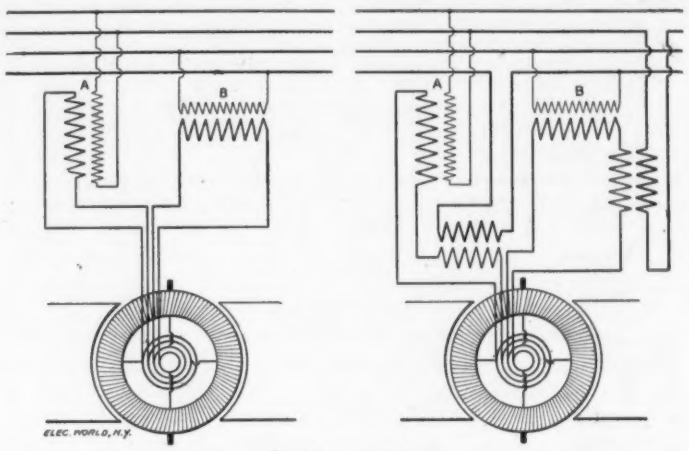
the current leads, the armature currents will rise before the collector ring leads have come into the vertical line, and there will be a component horizontal armature magnetization tending to help the field magnetization. With multiphase leads this distortion and reaction becomes continuous instead of intermittent.

This applies both to generators and motors, and leads to the further interesting property of alternating currents that in case a synchronous motor is worked with a field excitation too low to generate the proper back E. M. F., lagging currents will flow, and in the manner described build up the field magnetization, at the same time reducing the magnetization of the generator; the reverse effect taking place if the field magnetization is too high. In fact, a synchronous motor may and often is worked with no field exciting coils whatever, the inductive action alone of lagging currents being depended upon.

The application of the ideas shown in the patent of Mr. Edwin W. Rice, Jr., will be considered first in connection with rotary transformers used for field excitafion, the actual conditions of the installation at the Niagara Falls power plant being considered to show a particular application. In this great plant ordinary transformers are used to step down the pressure of the two-phase, 2000-volt main generator terminals to a voltage suitable for introduction into the armature windings of the rotary converters supplying the direct current for the excitation of the main generator fields. These transformers are shown in their proper vectorial relation at *A* and *B*, Fig. 3. With this simple arrangement the voltage across the commutator brushes of the rotary is constant so long as the line pressure of the alternators is constant, as the ratio of transformation of a rotary is as definitely fixed as that of a direct current motor generator with one field. There is no automatic compounding device, the field excitation being controlled by the attendant, as the loads change, with the aid of a rheostat in series with the main fields.

If, however, as proposed in the the patent of Mr. E. W. Rice, Jr., the main generator leads are inductively connected to the transformers, *A* and *B*, as indicated in Fig. 4, there will be superposed on the E. M. F. in the shunt coils *A* and *B*, a further excitation increasing with the load. The connections should be so made that this increased E. M. F. in the rotary circuits combines vectorially with the E. M. F. generated by the shunt coils, as indicated in the diagram. When, therefore, a non-inductive load is thrown on the machine, the E. M. F. in each exciter alternating circuit increases, due to the combination of these two E. M. Fs. out of phase with each other by one-quarter period. If, however, the load becomes inductive and the current in the main line lags, its effect comes more nearly in phase with that of the shunt coils, *A* and *B*, and the alternating voltage across the exciter collector rings rises, causing, as described above, an increase of the pressure across the direct current end of the exciting rotary, and consequently an increased field current in the main generators. If, on the contrary, leading currents pass out from the generator, due to a load with negative inductance, or what is sometimes known as a condenser load, the series coils will come more nearly in opposition to the shunt coils and reduce the voltage across the exciter terminals, thereby reducing the field excitation of the main generators.

This obviously is a highly desirable result, as the internal effect of the lagging currents in the main generators is to demagnetize the fields, while their action through the exciter is the reverse, the



FIGS. 3 AND 4.

latter thus providing a suitable compensation, which automatically regulates both for variation of the magnitude and the phase relations of the load. The superposition of two alternating E. M. Fs. differing from each other in the stationary transformers will, of course, cause a considerable flow of wattless currents in *A* and *B*, but their effect is probably not serious.

The method also applies to mechanically driven exciters, which are kept in proper synchronous relation with the main generators, either by means of synchronous motors or by rigid mechanical connection. In the latter case the exciter, if direct coupled, must have the same number of poles as the generator, there being a possibility of working it with a smaller number of poles with suitable gearing. The arrangement comprises two or more collector rings connected with the exciter winding itself or an auxiliary winding on the same core, and carrying either the main line current from the generator or currents derived inductively therefrom by suitable series transformers. The phase relation being properly adjusted, the currents introduced through these collector rings react, as described above, on the field magnetization, increasing it as the load increases, and still further increasing it with increase of lag, the leading currents tending, on the contrary, to diminish the field excitation, this combination giving the proper compounding of the generator fields without rectification or commutation of the alternating currents.

In the patent there is a description of the application to a belt-driven exciter, but this is obviously impractical, as when, due to a load on the main machine, alternating currents are introduced into the exciter, it will tend to adjust itself in step with them and act as a synchronous motor, the effect of the belt being to greatly complicate matters and being different with every variation of the exciter load or the belt tension. Whenever excitation is derived from machines synchronously rotated with the main generators, either by mechanical or electrical connections, this system can be used and will undoubtedly be found highly advantageous.

The Parallel Operation of Compound Dynamos.

BY GEORGE T. HANCHETT.

An objection that has been urged against the operation of compound dynamos in multiple is their failure to regulate for line loss with accuracy. A single machine, it is true, if properly designed, will raise the voltage in proportion to the load, but when the station load consists of the output of two or more machines the voltage of each machine is raised in direct proportion to its individual load, and the result cannot be accurate. Illustration will make this matter more plain.

Suppose that we have three machines, which for simplicity's sake we will assume are all of one size, and that the wiring system is constructed for a 6-volt loss in the line, or a maximum load potential at the station bus-bars of 116 volts. It is easy to see that if the load on the line should be one-third of the total, convenience and economy would dictate that a single machine should carry it, with the result that unless the rheostat were adjusted the line voltage would be that of the machine at full load, 116, or 4 volts too high. This difficulty has provoked considerable discussion, and the writer ventures to offer the following solution, which may be of interest.

In the compound wound machine the series coil must give proper increase of field excitation as the load rises, to compensate for the drop of voltage, due to the following causes: First, the reduction in speed of the source of driving power; second, the slip of the belt if such is used; third, the drop due to the resistance of the armature and series field; fourth, the drop due to the demagnetizing and cross-magnetizing effect of the armature, and finally the drop in the conductors from the dynamo to the point at which constant potential is desired. All these losses of voltage except the last are approximately proportional to the current flowing in the machine, and may be compensated for by a simple series coil, provided the field magnet is worked on some straight portion of the magnetizing curve where an increase of the magnetic induction due to any given increase of magnetizing force will be constant within the range of working; or in other words, where $d\,B/d\,H$ is constant; or where shunts of proper temperature co-efficients are applied to make the increase in magnetization proportional to the aggregate drop. The last factor, namely, the drop in the conductors, has, on the contrary, no fixed ratio to the current in the machine. If only one machine is used the drop in the conductors bears a certain ratio to the current in the machine, while if two machines of the same capacity are used the ratio is twice as great, and so on. In other words, if one machine is properly over-compounded to compensate for this drop, with two such machines running in parallel the line current, and therefore the drop, would be twice as great and the compensation just the same, which obviously fails to properly accomplish the principle of over-compounding.

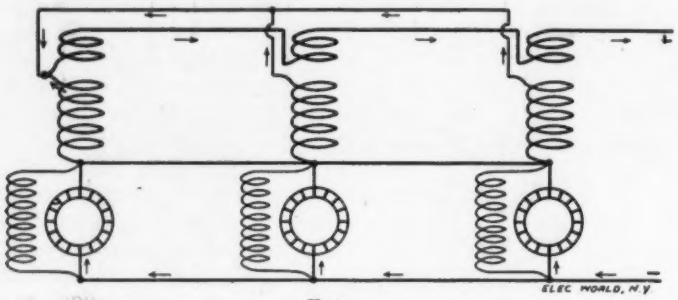


FIG. 1.

One way of remedying this difficulty would be the provision on each dynamo of a series coil connected in the usual manner, designed to compensate for all losses in the machine itself, and a separate series coil carrying only the main line current, with the proper number of turns to further build up the voltage of the dynamos to compensate for the loss in the main lines. Such an arrangement is shown in Fig. 1, in which the lower and larger coils are connected up as usual between the equalizer and terminal bus, and the upper and smaller series coils are connected in series with each other carrying the main line current. These coils could be left in circuit continuously, in which case they would serve to give the initial excitation in the proper direction. The current in any of them would obviously be simply that in the main conductors, and their influence, therefore, would be, assuming proper magnetic conditions, such as to exactly compensate for the drop in the main conductors, no matter how many dynamos were running. In large stations coils for such heavy currents as those carried by the main bus bars would be difficult to construct and connect, and if some arrangement could be devised by which the currents in the field of each dynamo could be no greater than in the armature the result would be more practical. Obviously it is impossible to connect these auxiliary coils in multiple with each other instead of in series, and with proper winding and cross connecting leads to make the multiple arrangement perform the same service. The cross connecting leads in this case, of course, would have to be, as in the ordinary machines, of a resistance relatively negligible with that of the coils themselves, the resistance of which would be inversely proportional to the capacity of their respective machines. Fig. 2 shows a simple diagrammatic

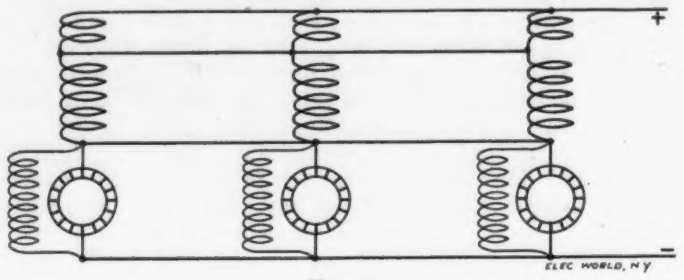


FIG. 2.

sketch of dynamos so connected, from which the arrangement will be seen to be very simple, consisting merely of an auxiliary equalizer permanently connecting in multiple a portion of the series coils. The arrangement is very similar to that of the conventional compound systems, three leads being carried through the main switches, the only addition being an auxilliary equalizer and main bus bar between the machines, and not necessarily running from the switchboard to each separate machine.

The practical application of such a system would in most cases be very simple; in the case of small machines designed to have but a single series coil the diagram shown in Fig. 2 could be literally followed, but in the case of machines where two or more coils are employed for series magnetization the result would be attained at the expense of a little additional complication. Fig. 3 shows the arrangement which would be well to use in the case of a multipolar machine. The series coils proper are wound the usual way, and a second set of series coils are separately connected so as to be in

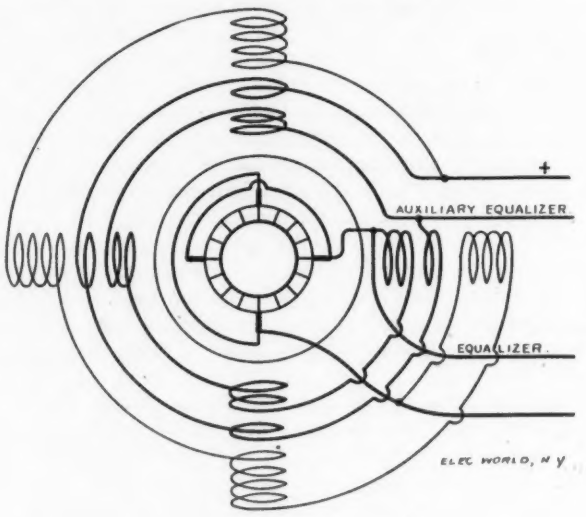


FIG. 3.

series with the first and yet designed so as to be properly shunted by similar coils on other machines.

In constructing the compound dynamo on this plan the procedure is obviously as follows: What may be termed the compounding coil should be designed so that the potential between its free end and the negative pole of the machine should be constant up to full load, and the auxiliary or what might be called the over compounding coil should be designed with reference to the over compounding coils of the machines with which it is to run in multiple, and a sufficient number of turns should be given to it, so that the current which it carries will magnetize the machine to produce the required percentage of over compounding at full station load.

A Memorable Anniversary.

BY GEORGE H. GUY.

The extraordinary extent and rapidity of the development of locomotion by electricity is one of the marvels of our time. The electric current has come much more quickly into general use for transportation than for lighting purposes. It is twenty years since Edison perfected the incandescent lamp, and twenty-five years since arc-lighting was first adopted. Surprising as it may be to most people, it is nevertheless a fact that this is only the tenth anniversary of the day on which the feasibility of regular electric street railway service was first fairly and commercially proved in this country. It was on the 3d of February, 1888, that this notable event took place on the lines of the Union Passenger Railway Company of Richmond, Va. It seems fit on this occasion to relate the story of the first efforts in this field, as well as to summarize the wonderful growth in a single decade of this new mechanical art to its present stupendous proportions.

The following account of the early work in Richmond is taken from a recent number of the New York *Evening Post:*

It is no exaggeration to say that the story of the Richmond road is one of the most thrilling recitals of the triumph of pluck and brains over apparently insurmountable obstacles to be found in industrial history.

The contract called for the completion in ninety days of the equipment of a road with 12 miles of track; the construction of a complete steam and electric station plant of 375-hp capacity; the furnishing of forty cars, with eighty motors, and all appurtenances necessary for their operation; thirty of the cars were to be operated at one time, and grades as high as 8 per cent. were to be ascended. The nerve required to take on hand such a task as this at the then immature stage of the industry becomes even more incredible in the face of Mr. F. J. Sprague's admission that "when the contract was signed we had only a blue print of a machine and some rough experimental apparatus. The hundred and one details which were essential to success were as yet undetermined. Fortunately for the future of electric railways the difficulties ahead could not be foretold, or the contract would not have been closed."

The situation is graphically conveyed in Mr. Sprague's own words. He says:

"The track was simply execrable, laid for profit, not for permanence, and with no idea of the necessities. It was a flat 27-pound tram rail of antiquated shape, poorly jointed, unevenly laid in red clay, and insecurely tied together. A part of the 12 miles of track was double, the rest single. Some of it was laid on paved streets, but the greater part was on macadam or unpaved streets. There are twenty-nine curves, five being less than 30 feet radius. On these sharp curves were grades as high as 8 per cent.; and there were straight grades as high as 10 per cent. The outer rails were often inches below the inner ones, and the whole track at times would disappear into the red clay, which froze over it and stuck with remarkable tenacity. Our car-house was an open lot, in which were two roughly covered sheds.

"We had undertaken the problem, at that time entirely new, of gearing motors independently to each axle, carrying them under the car, exposed to dirt and moisture, to control them from either end by new methods, to run with fixed brushes in both directions, to operate without rheostats, to use a 450-volt constant-potential circuit under conditions which were stated by electricians to be impossible. to operate a multiple-arc circuit on a large scale, which was deemed equally impracticable; to use a trolley wire of small size supplied at intervals by a system of large conductors, and to mount grades which we found much more severe than we had contracted for, and which had also been pronounced by street-railway men and electrical engineers as impossible of ascent by a self-propelled car."

Mr. Sprague went back to New York and a council was held. The most direct remedy which suggested itself was the introduction of an intermediate gear for the motors under the car. Before deciding on this Mr. E. H. Johnson, the president of the company, "guessed the best thing to do was to find out whether the car could get up the grade at all." Mr. Sprague went back to Richmond to find out. The trial trip was made at night about 9 o'clock, with Mr. Sprague, S. Dana Greene, General Manager Burt, and other employees on board the car. As Mr. Sprague describes it:

"A short distance from the end of the line we stopped in the middle of a very sharp curve. Burt thought we would not get out of it; I said I would if I wrecked the machines, and out of it the car came. Arriving at the foot of the hill we stopped, and I said: 'Burt, we won't make it.' He said: 'You will; if you can get out of a curve such as that we left, you can go up the side of a wall.' If we succeeded in climbing the hill, I knew what would happen to the machines, but it was vital to know whether a self-propelled car could be gotten up that grade. We went steadily up until we got to the top of that and another hill, and had gone around several curves, finally reaching the highest point of the line in the heart of the city. We stopped here, for I knew that everything under the car must be pretty nearly red hot, and an enthusiastic crowd soon gathered around us. Of course, I was willing that they should inspect the car, for all the time I was in hopes it would cool down sufficiently for us to continue our journey.

"But my hopes were doomed to disappointment. No sooner had we started than I felt that peculiar movement, then strange, but afterward very familiar, due to a crossed armature, and I knew that we were disabled. We ran along a block in our crippled condition, and then I stopped, while a howling mob, numbering two or three thousand, seemed bent on taking possession. It would never do to confess serious trouble, and so I told Greene in a tone that could be overheard by those near me, but apparently showing no concern, that we probably had some slight trouble with the circuits, and I thought he had better go and get the instruments, so that we could locate it and put things to rights. Then I turned out the lights and laid down on a seat to wait, hoping that the crowd would disappear. After a while Greene returned with 'the instruments,' four big, powerful mules, the most effective instruments which we could find in Richmond under the circumstances, and we began our retrograde journey."

After the gear question had been settled, difficulties of all sorts cropped up thickly. The field magnets were wound in sections, the insulation was crude, and the work hastily done, and grounds and crosses were frequent; the armatures were double-ended, that is, they had a commutator on each end, and were connected in such a way as to bring the brushes at each side on top, so that they could be adjusted or inspected from the car. The overhead work in the matter of switches was giving trouble, and not less than fifty or sixty designs of trolleys of every conceivable shape and character were devised and brought out. Beforethe final adoption of carbon, first used for this purpose commercially by Van Depoele, the variety of brushes tried was without number. "At first we used flat ones, solid and laminated, which would wear through, double over, and hug an arc of the commutator, or oblique solid and laminated brushes, which would catch in the bars, reverse and split, and straddle half a dozen bars, with the result of ruined commutators, crossed armatures, and burnt-out fields." Mr. Sprague continues: "My heart often ached to see a loaded car climbing a grade, with a lurid green glare lighting up the track, and no hope of getting at it, although I knew a hundred dollars of damage would be the result of that trip. Then we tried tilting brushes, and then variously shaped pieces of copper, bronze and brass, set on end, and pressed down by springs of all kinds, and sometimes solid bars of brass set on end. About this time, the track looked like a golden path, for the rough bars acted like milling cutters and sheared off the ends of our contact bars with marvellous rapidity, sending a shower of shimmering scales over machine and roadway. At this period we were using about nine dollars' worth of brass per day for brushes; not a half trip was made without inspection, and generally with a change of brushes; but the road had to be kept in operation somehow while other experiments were being made."

Setting aside the immense amount of original work thus hinted at and strenuously elaborated by Mr. Sprague during this period of experimentation, an inestimable result of his labors at Richmond was to incorporate into the art many distinctive valuable features, some of which had originated with others, but which then became crystallized and uniform and standard—such points, for instance, as placing the motors under the car; operating two motors instead of depending upon one; methods of suspending the motors under the cars; methods for insulating the various component parts; apparatus for motor control; features of car-wiring; substituting heavy motors for light and inadequate ones; improved trolley poles and trolley wheels and trolley-wire suspension; features of cross-overs and switches; the experiments with the brushes on the motors; the adoption of improved methods of gearing between the motors and the car-axle, in place of the usual sprocket and chain; methods of protecting the motors from the mud, slush, and ice through which they had to run, and hosts of others.

"The Relations Between the Customer, the Consulting Engineer and the Electrical Manufacturer."

To the Editor of The Electrical World:

Sir:—Mr. S. Dana Greene's paper on the "Relations Between the Customer, the Consulting Engineer and the Electrical Manufacturer," is a most temperate and timely contribution, and I, for one, thoroughly agree with him in a great deal that he says. At the same time, I think that the friction between the manufacturer and the consulting engineer is largely the outcome of the former's opinion that the latter is unnecessary, and that business, if transacted directly between agents and customer, would result in better prices and less trouble. It is principally the larger manufacturers who object to the retaining of independent engineers, as such engineers look to the quality of goods and their price, without attaching great weight to other arguments which agents are accustomed to use, such as extent of business, etc. A consulting engineer, however, is, in fact, more of a safeguard than a hindrance to that large section of the manufacturing community who conduct their business on honorable lines; and granting that he is as he should be, strictly impartial, and perfectly upright, a disappointed manufacturer should, instead of casting slurs on the engineer, set to work to either improve the quality, or lower the price of his goods. In his professional capacity a consulting engineer is a trustee in a particular case, for the whole manufacturing industry, as well as for his client, and manufacturers with small capital, without the means for extensive advertising, have just the prospect of success in his hands that the quality of their apparatus merits. This is my conception of the functions of a consulting engineer, and I am sure that with the exception of a very few giant corporations the whole electrical manufacturing industry has no cause for complaint against the consulting branch.

Alternating apparatus is rapidly coming into favor just now, and some manufacturers make only such machinery. There are, however, cases most favorable for direct-current work; where, while the alternating specialist recommends such apparatus for every and all cases, the consulting engineer takes care of the interests not only of his client, but also of the numerous manufacturers of direct-current apparatus. And conversely, in the case of extensive enterprises—railways or power transmissions—no manufacturer can give the time to study the conditions properly, so as to work out the best result, and it will be found that the objections against the engineer come not from the many "specialist" companies who devote their entire attention to perfecting one kind of apparatus, but from the one or two monopolists who fail to gobble the whole. Every "specialist" company should be the most enthusiastic supporter of the consulting branch.

As regards "standardizing" versus "specializing," I consider that to standardize everything would be to actually hinder engineering progress. No engineer ever finds two separate cases exactly alike. Standardize broadly, if you like, but not comprehensively. Engineering should come first; cost of apparatus and convenience in manufacture second. I quite agree with Mr. Greene that specifications often specify too much, and that details of design and construction are the manufacturer's, not the consulting engineer's business. An engineer should specify sizes, etc., and the conditions under which the plant will operate, leaving a manufacturer to do what he can, or what his factory facilities enable him. All manufacturers will do good work, and tests will prove value. It is desirable that harmony should be promoted. This can only be done by manufacturers recognizing that no one is entitled to a monopoly of business, and by consulting engineers being perfectly independent of manufacturing interests, and of rigid integrity.

Toronto, Ontario. George White-Fraser.

The Damage to Pole Lines.

The recent severe snow and sleet storm in New England caused losses in and around the city of Boston to the various owners estimated as follows:

Western Union Telegraph Company	$20,000
Postal Telegraph Company	10,000
Long Distance Telephone Company	5,000
New England Telephone Company	10,000
Electric light companies	4,000
Fire and police signal service	5,000

The Management of Central Station Meter Systems.

To the Editor of The Electrical World:

Sir:—Referring to the article in The Electrical World of January 1, by Caryl D. Haskins, on "The Management of Central Station Meter Systems," I quite agree with him as to the trouble which arises with meters of large capacity, giving incorrect records when a small number of lights are burning.

He proposes using two or more meters and wiring the building in such a way that halls and other places where the lights are used in small numbers and long hours could be on a meter of small capacity, and other circuits where none or all the lights are used could be on a larger meter. This, of course, would to a great extent help the difficulty, but in many places it is quite impossible to predetermine where the lights are going to burn in small quantities and long hours and vice versa.

I would suggest that we have, as mentioned by Mr. Haskins, two meters, one of large and one of small capacity, wired to a two-way automatic switch so that but one would register at a time, the switch being arranged to keep the small meter in circuit with currents less than its capacity and the large meter with larger currents. This would work the meters nearer their maximum capacity, and thus give better results.

The details of the automatic switch I have not worked out, but that is, I think, a minor consideration.

William H. McDowell.

Fishkill-on-Hudson,

The Third Rail System in the Snow.

The great snowstorm of January 31, 1898, which raged over New England, has proved that a railroad can be operated by the third rail electric system under the most adverse conditions. That portion of the New York, New Haven and Hartford Railroad, between New Britain and Hartford, operated by electricity, was kept open during the whole of that day, and the trains were run with but a few seconds delay in the schedule, while the steam trains on the main lines were held up and delayed for three or four hours.

A heavy snowstorm had long been desired by the electrical engineers and railroad officials in order that as severe a test as possible might be applied to the third-rail system. It has been a question whether, with the third rail, practically surrounded by snow and moisture, the current leakage would seriously affect the operation of the motors on the cars. This question was settled by the snowstorm. There was absolutely no leakage, and, once the heaviest part of the snowfall was removed by the snowplows, no interruption in the motor-car service occurred.

Col. N. H. Heft, chief electrical engineer of the New York, New Haven and Hartford Railroad, and the engineers of the General Electric Company, express great satisfaction at the performance of the entire system under the severe climatic conditions.

Lighting from a Railroad Circuit.

The New York, New Haven and Hartford Railroad has arranged to light its station in Hartford by power derived from the conductors of its third-rail system running in from Berlin. To obtain a proper voltage and sufficiently close regulation a motor generator has been installed, consisting of a shunt wound 500-volt motor coupled to a shunt wound 125-volt generator, and supplying the current to a storage battery. This consists of sixty-six cells of chloride accumulator type "11 G," with a capacity of 800 ampere hours. The battery not only gives current for lighting purposes, but steadies somewhat the voltage of the third-rail system at the Hartford end.

Public Lighting in Detroit.

The report of the Public Lighting Commission of Detroit for the six months ending with December 31, 1897, shows a very satisfactory condition of affairs. The electrical output of the station, which is owned and worked by the city, has increased from 1,526,359 kw hours to 1,646,505 kw hours, while the cost of producing 1000-kw hours has fallen from $37.62 to $30.55 since the publication of the last semi-annual report. From present indications the Commission expects to enter the next fiscal year with a comfortable surplus of $67,500 on hand.

Digest of Current Electrical Literature

American and Foreign.

by Carl Hering.

Dynamos, Motors and Transformers.

SPARKLESS MACHINES. Atkinson. Lond. "Elec.," Jan. 21.—A brief communication referring to the article by Fischer-Hinnen (see *Digest*, last week). He states that an almost identical method is found in Swinburne's original paper, except in one particular; Swinburne stated that one disadvantage is that the reversing coil is also a compensating coil, and the two effects may not be required in the same proportion; this is obviated by Fischer-Hinnen's method, but the objection to the latter is that the length of a turn on the magnet bar is necessarily much greater than on the reversing pole, and as the number of ampere turns required is the same as that on the armature, as was shown by Ravenshaw, the result is that the copper required for the reversing arrangement is nearly the same as that on the armature; the cost and size of the machine are therefore increased; data will soon be forthcoming showing a commercial saving in one such method.

Housman, in the same journal, also claims that the method is not new, giving a reference to an old English patent. The most important condition was omitted by Fischer-Hinnen, namely, that the unbalanced part of the winding on the two sides of the auxiliary pole must consist of series turns, or, otherwise, sparkless commutation will be attained for only one value of the armature current; this involves considerable overcompounding, so that it is in general better to wind most of the series turns on the intermediate magnet itself, thus allowing the turns of the magnet to be kept small; many machines of this kind have been made during the past ten years in England, which run absolutely without a spark. Menges also claims priority of invention.

SINGLE-PHASE MOTORS. Eborall. Lond. "Elec. Rev.," Jan. 21.—A continuation of his article (see *Digest*, last week). He describes the starting of those motors, and gives the results of some tests made by him; the motor has the advantages that it starts well with a heavy load without any external complications or excessive current; it stands considerable overload; the power factor and efficiency are high, and the speed is absolutely constant; the defects are that it is expensive, noisy when unloaded, that the centrifugal device might fail, and that the no load current is rather high; such a motor would make a good rotary converter. He then discusses briefly alternating field motors, which are merely laminated field continuous current motors; their efficiency is low, and the no load current large, with a very low power factor; they have a low weight efficiency, and there is bad sparking; these inherent defects have not yet been overcome, and the motors are therefore unsuitable for anything but small work; with a very low frequency of 15 to 20 the defects are greatly minimized. He then discusses induction motors, which probably constitute 75 per cent. of all the single-phase motors used on the continent; the elements of these are described.

SHIELDED CONDUCTORS. Price. Lond. "Elec. Rev.," Jan. 21.—The conclusion of his article (see *Digest*, last week). He discusses Russell's experiment; regarding refrangibility, he shows that it applies only when neither medium is coercive; the law is little more than a guide in drawing diagrams. He suggests a paradox; a space is enclosed by a shield formed of bar magnets placed side by side, with all their north poles outside and all their south poles inside, and he claims that there can then be no flux, and that, consequently, they cease to be magnets. (Judging from a drawing, he does not seem to be correct in this. If the shell were a complete sphere, the magnets being all radial, his argument might be more nearly correct.)

CLOSED ARMATURE WINDINGS FOR CONTINUOUS CURRENT MACHINES.—"Zeit. fuer Elek.," Jan. 9.—A long illustrated article compiled from a recent discussion between Reithoffer, Eichberg and Kallir, and intended to give an insight into the "winding formula," and to lead to a generalization of the formula given by Arnold. It is accompanied by a number of diagrams and formulas.

Lights and Lighting.

COST OF ARTIFICIAL LIGHT. Wedding. "Elek. Anz.," Jan. 16.—A reprint of a table giving the consumption of materials, production of heat, and the price per hour, for a number of different methods of illumination; the cheapest appears to be the petroleum incandescent light.

DIFFUSED ILLUMINATION. Kermauner and Prausmitz. "Prog. Age," Feb. 1.—An article translated from the German, investigating the proper distribution of lamps in large halls, and the number which are to be used; it refers to incandescent gas lights, but some of the conclusions are of equal interest for electric lighting. The rooms were whitewashed, the light was reflected on to the ceiling by reflectors below the lamps, and the illumination in different parts of the rooms was measured; all the direct light was cut off. The result of the method is remarkable; the light at first seems insufficient, but after a short time it was found extremely pleasant; there are conditions under which indirect, or diffused light, is actually brighter than direct, a result which is of great importance. Cohn gave the rule that every place must have 1.04 foot candles of illumination, but the recent experiment shows that this as a minimum is too high for schools and lecture rooms, and it is more than in an ordinary room with good daylight; if the light does not fall below 0.73 to 0.83, the room is well enough lighted when there are no shadows and nothing to dazzle the eyes; specially fine work would require more light, but for ordinary purposes the latter figures are amply sufficient. The lamps should be distibuted uniformly, and the distance between them and the walls should be about half the distance between the lamps.

INCANDESCENT LAMPS. Maxim. "Elec. Rev.," Feb. 2.—A reprint of the article noticed in the *Digest*, last week.

Power.

UTILIZATION OF THE PEAT IN GERMANY.—"Elek. Anz.,"—A long abstract of a recent lecture by Frank on the utilization of the large peat formations in Germany; he calculates that the equivalent of 200 tons of hard coal is 600 tons of peat; the material is therefore too bulky for transportation, and the peat deposits should therefore be considered as local sources of power, like a waterfall; he suggests converging the energy in it into electrical energy for local purposes, or for transmission; some figures are also given.

ELECTRIC ELEVATOR.—Lond. "Elec.," Jan. 21.—An illustrated description of two forms of the Oerlikon elevators, which carry their own motors, and which have been used for a number of years with success. The motor, which is attached below the elevator, carries a worm gear at each end of its shaft, and these operate on a vertical rack; the three-phase current is used.

POWER IN MINES.—"Zeit. fuer Elek.," Jan. 16.—The beginning of an illustrated description of some of the apparatus of Siemens & Halske.

CHEAP ELECTRICITY.—Lond. "Elec. Rev.," Jan. 21.—A criticism of the discussion in the Lond. "Engineer" of Raworth's recent presidential address.

ELECTRICITY IN AGRICULTURE. Meyer. "Elek. Anz.," Jan. 16.—Illustrated descriptions of various machines and apparatus.

GOVERNING ELECTRIC LIGHT ENGINES.—Lond. "Elec. Eng.," Jan. 21.—Several answers to a request to furnish illustrated descriptions of the best system.

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108 MILE TRANSMISSION PLANT.—"Eng'ing News," Feb. 3.—A note stating that a plant in Southern California is under construction, in which the power of the Kern River will be sent to Los Angeles; the total power is about 12,000 horse-power; 30,000 volts is proposed.

MONTANA POWER COMPANY. Tandy. "St. Ry. Jour.," Feb.—A description of a large water-power plant near Butte, Mont. The power station will contain five 1000-hp turbines; power will be transmitted to Butte, 21 miles distant, at 15,000 volts. The entire cost of dam, machinery and line was $400,000.

ELECTRICAL SHOP TRANSMISSION. Dimick. "West. Elec.," Jan. 29.—A reprint of a short paper read before the Chicago Electrical Association, in which he limits himself to a plain two-wire, 220-volt system, and motors belted to the line shafting; he describes some of the apparatus used in a certain installation.

ELECTRICITY FOR OPERATING TURRETS.—"Cassier's Mag.," Feb.—A note from a recent Navy Department report giving the results of the use of electricity, and showing its advantages over steam and water.

COMPACT GENERATING UNIT.—"Power," Feb.—An illustrated description of the direct-coupled generating unit recently installed in the Twelfth street station of the Edison Company, of New York; it refers almost entirely to the engine.

Traction.

ACCUMULATOR TRACTION. Hauswald. "Elek. Zeit.," Jan. 20.—An abstract of a recent paper referring to the Pollak accumulators. One kw hour at 1 to 2 hour discharges requires 100 kg of cells complete, the price of which is $50 to $63; for 10 hour discharges the weight is only 60 kg. With rapid discharges he found that there are two laws, first that the plates will stand strong currents only intermittently, and that the higher the efficiency in watt hours, the greater the life. The present conditions for traction are said to be as follows: The weight of the car, 6 tons; passengers, 1 ton; energy per car km, 60 watt hours; speed, 15 km; daily run, 170 km, or 130 including repairs; the measurements in Frankfort

showed a mean consumption of 33 watt hours per ton km. The wearing of the rails due to the battery is much less than that due to the weight of the motor and the slippage of the driving wheels, which exists on all electric lines; the conditions for running for a full day on one charge are discussed, and the disadvantages pointed out, as compared with the system of charging very frequently, which produces a more constant load, and requires a smaller central station. The system used in Frankfort is then described, the load diagram being given; the charging voltage is 210, and an overcharging is thereby prevented, which is very important; during the past three months the results have been exceedingly economical, and the efficiency of the battery was 80 per cent.; the cost of the current and attendance, including that of car and battery, was 1.6 cents per car km, the cost of the current being 3 cents per kw hour; roller bearings were used. The mixed system is discussed, the chief advantage of which is the light battery; in comparison with the conduit system, it will be much cheaper. In conclusion, he calculates whether accumulators would be profitable on present steam lines, assuming a weight of 13 tons per car; with a speed of 60 km, the consumption will be 80 km; the maximum distance will be 90 km, from which it follows that it would be profitable only for suburban lines, on which, however, there would be a very great saving.

ELECTRIC RAILWAYS IN THE UNITED KINGDOM.—Lond. "Elec.," Jan. 31.—A supplement in the form of a large folded plate, giving well-filled columns of data for those in operation, in progress and projected. There are some twenty-three lines in operation; twenty-five others will probably commence running before the year is ended; there are projected schemes for ten underground electric railways in London, and forty-eight light railways in London and the Provinces. Those in operation, including those which will be running within a few weeks, have a total length of over 150 miles of track; or, including those in course of construction, about 400 miles. By far the greater number use the overhead trolley system, neither the battery nor the conduit system having advanced, and there is no instance of the use of the surface contact system; the third-rail system is reserved exclusively for underground and overhead railways.

ELECTRIC RAILWAY STATISTICS.—"Elek. Anz.," Jan. 9.—A large table giving some data of the thirty-three electric railways constructed by the Union Company in Germany and other countries.

BUDAPEST.—Lond. "Elec.," Jan. 21.—A note abstracted from a German journal, stating that all the lines in Budapest are now operated electrically, the length being 110 miles of track, of which about one-third are worked on the underground system, and the remainder with overhead lines; the oldest line was built in 1889, on the underground conduit system.

CONTACT SYSTEM.—"Elek. Anz.," Jan. 16.—An illustrated description of the Bersier, or "spoon-car," system, which has been tried recently in Havre. The car carries a long bar beneath it and over one of the rails, next to which is a groove in which passes an apparatus for operating the intermittently-placed contact boxes, which render the succeeding sections live.

ELECTRIC TRAMWAYS OF SWITZERLAND. Rochat. "St. Ry. Jour." (Internat. Ed.), Feb.—There are now 110.517 km of electric track, and this will probably be doubled within the next two years. A table gives the technical details of all the installations; another gives the financial date. The rails usually weigh from 30 to 33 kg. per running metre; the gauge is usually 1 metre; the maximum grade is 11.3 per cent. at Lausanne; illustrations show the different forms of overhead construction used; Mannesmann steel poles are extensively used; the insulators are all of American types; the trolley wire is generally divided into sections 500 ms. in length. Much attention has been given to securing a good ground return, as this has been found to reduce the disturbances in the telephone wires running parallel to the track. Where alternating currents are used on the trolley line, as at Lugano, it is necessary to use an insulated return for the telephone lines where they run parallel to the track; the success of the triphase current at Lugano has been considerable, and a number of roads propose using this system. The maximum voltage allowed for electric tramways and railroads by the government is as follows: For railways operating only over their own right of way, alternating current, 750 volts; continuous current, 1000 volts; for interurban tramways, alternating current, 550 volts; continuous current, 750 volts; for city tramways, alternating current, 400 volts; continuous current, 600 volts; these limits were fixed after a series of experiments conducted by Weber, who took in person, and administered to others, currents under different conditions up to 2000 volts.

TRAMWAYS IN DENMARK AND THE SCANDINAVIAN PENINSULA.—"St. Ry. Jour." (Internat. Ed.), Feb.—A summary of the present tramway conditions. Copenhagen is the only city in Denmark which has tramways; there are 68 km. of horse and electric lines in this city. In Sweden there are three cities having tramways, and in Norway, two. A number of applications are pending both in Norway and Sweden.

WATERLOO AND CEDAR FALLS SUBURBAN RAILROAD.—"St. Ry. Jour.," Feb.—A description of this line, 9 miles in length, connecting two cities; there are two motor and two trail cars, fitted with air brakes and electric heaters.

PITTSBURG.—"St. Ry. Jour.," Feb.—Description of proposed changes. The Consolidated Traction Company will abandon several of its four old stations, and install a new one on the Allegheny River. Half of the trolley lines will be operated with 500 volts positive and half with 500 volts negative, the track being made the neutral side of the system; to secure proper balancing between the two sides, certain sections will be arranged so that they can be switched on to either positive or negative side, by means of section insulators; as a general rule the current will be fed in at the ends of the lines, so that a constant potential will be secured throughout each section. In addition, storage batteries will be used for maintaining the potential. In changing the system to electricity a large amount of cable conduit was removed by blasting.

KANSAS CITY.—"St. Ry. Jour.," Feb.—An illustrated description of the system of the Metropolitan Railway Company. The population is 171,000; the railway systems are consolidated, and comprise about 136 miles of track; it shows the larger number of stations required to operate a cable system than an electric one; there are seven cable stations, although all the cable lines are in the same section of the city; the cable machinery in one of these stations is operated by an electric motor, which takes power from one of the electric stations; the cost of operation of this station per month with electric motor is $366.23, as compared with $1025.52 when operated by steam power. The Central avenue power station, which is the principal electric station, is a modern plant, and is fully described. From July to October, during which the station had a total output of 310,338 kw hours, the average cost per kw hour was $0.004874. Cast welded joints are used extensively.

INTERURBAN FREIGHT AND EXPRESS LINE.—"St. Ry. Jour.," Feb.—A description of the line of the Mahoning Valley Railway Company, of Youngstown, Ohio. A special car is employed for this purpose.

REPAIR SHOPS OF THE CINCINNATI STREET RAILWAY COMPANY.—"St. Ry. Jour.," Feb.—An illustrated description; the shops cover nearly 8 acres.

ELECTROLYSIS FROM RETURN CURRENTS. Farnham. "Elec. Rev.," Feb. 2.—He believes that engineers and journals do not underestimate the damage which is quietly, but surely, progressing; the dangers which he predicted for the Brooklyn Bridge could be avoided by comparatively inexpensive means for drawing the current out of the bridge; the communication is very short.

RAILWAY MOTORS. Hanchett. "St. Ry. Jour.," Feb.—The subject of bearings and bearing lubricants is discussed. He does not approve of the use of any lead in metals of this kind, but prefers genuine "babbit," which is almost pure tin, with enough copper to make it tenacious and enough antimony to make it flow well. Grease is the best lubricant for motor bearings, and the author gives some receipes for making it; a general recipe includes tallow, palm oil and soda; he also gives a recipe for graphite grease.

Installations, Systems and Appliances.

LIGHT AND POWER FOR THE GLASGOW SUBWAY.—Lond. "Elec. Eng.," Jan. 21.—An illustrated description of the electric systems used in this underground cable subway, for lighting the cars, stations, etc., and operating the elevators, pumps, etc.; the current for lighting the cars appears to be obtained from a contact rail. It seems that the article is to be continued.

ACCUMULATOR BOOSTER. Simon. "L'Elec.," Jan. 22.—A short, illusrated description of a system which he used with success, in which a small booster is placed above the dynamo and belted to it; the excitation is constant, and the regulation is brought about entirely by changing the position of the brushes, which it is claimed is not accompanied by any sparking.

Wires, Wiring and Conduits.

FEEDING BOXES—Lond. "Elec. Eng., Jan. 21—Several answers to a request for illustrated descriptions of the best arrangement at a feeding point for a triple concentric cable system with four distributers at the end of one feeder.

Electro-Physics and Magnetism.

TRANSFORMATION OF ENERGY IN THE ELECTRIC ARC. Lond. "Elec. Rev.," Jan. 21.—A short editorial article discussing this subject. All attempts to represent the heat in the arc as due to a resistance and a back E. M. F., that is, as the sum of two terms containing the first and second powers of the current, have been futile. The recent suggestion of Fleming is discussed (see *Digest*, Jan. 29), and it concluded that the whole fall of potential in the arc is at or near the positive crater, where the disruption of matter takes place; little assistance in in this question is expected from analogies drawn from the phenomena of electrical conduction in solids, as it is allied rather to discharge in rarefied gases and movements in electrolytic solutions.

STRATIFIED DISCHARGE IN OPEN AIR. Toepler. "Wied. Ann.," No. 13; abstracted in the Lond. "Elec.," Jan. 21.—When the discharge of a large battery of Leyden jars is retarded by high resistances, a stratification is often seen; he succeeded in obtaining a sharply stratified discharge at atmospheric pressure, which closely resembles the stratified anode light. The general conclusion is that there is no essential difference between the ordinary spark discharges and the vacuum discharges.

ELECTROSTATIC VIBRATIONS. Melde. "Wied. Ann.," No. 13; abstracted in the Lond. "Elec.," Jan. 21.—He used electrical discharges for producing vibrations of strings, for which elec-

tromagnets were formerly used; an insulated metallic thread is stretched horizontally between the knobs of an influence machine; by suitable adjustment it may be made to vibrate as a whole or in parts.

ELECTRICAL HYPOTHESIS FOR THE SOLAR SYSTEMS. Delta. Lond. "Elec. Rev., Jan. 21—An article offering an electrical hypothesis for the solar and planetary system and some of the associated phenomena.

PHOTO-ELECTRIC PHENOMENA. Luggin. Lond. "Elec. Rev.," Jan. 21; abstracted from the "Zeit. f. Phys. Chem., " 23, p. 577.—Since describing, in 1894, a form of electrode which is considerably more sensitive to light, he made investigations with it, which he describes in this long paper, a brief abstract of which is given in this English journal.

VECTOR ALGEBRA APPLIED TO ALTERNATING CURRENTS. Rhodes. Lond. "Elec. Rev.," Jan. 14 and 21.—The conclusion of his series of articles (see *Digest*, Jan. 29); he discusses circuits containing a resistance, a self-induction and a capacity; also combinations of circuits, concluding with transformers and motors.

ATOMIC MAGNETISM. Jaeger and Meyer. "Wied. Ann.," No. 13; abstracted in the Lond. "Elec.," Jan. 21.—They found a new and simple relation between the para-magnetic metals, which is claimed to be of great interest. They investigated the magnetic susceptibilities of certain salts of the magnetic metals for various fields and at various temperatures, and found that the nature of the salt makes no difference, the metallic atoms alone being of influence. They found that the metallic magnetism of nickel, cobalt, iron and manganese was strictly in the ratio of 2 to 4 to 5 to 6; probably chromium fills the gap between nickel and cobalt. This may shed a new light on the magnetic behavior of the elements.

MAGNETISM AND DIAMAGNETISM. Fleming. Lond. "Elec." and Lond. "Elec. Eng.," Jan. 21.—A syllabus of a course of five lectures to be given at the Royal Institution.

FERRO-MAGNETIC HYPOTHESIS. Fleming. Lond. "Elec.," Jan. 21.—A reply to the criticism of Haye (see *Digest*, last week). He claims that the critic took particular sentences away from their context and thus interpreted him incorrectly.

MAGNETIC AFTER-EFFECT. Klemenchich. "Wied. Ann.," No. 13; abstracted, with some curves, in the Lond. "Elec.," Jan. 21. —Soft iron in a weak field does not assume the maximum magnetization until after the lapse of several minutes; this is called viscous magnetic hysteresis and magnetic after-effect. He shows that instead of disappearing in strong fields it goes on increasing, but not at the same rate as the total magnetization, the proportion becoming less.

SOURCE OF X-RAYS. Trowbridge and Bourbank. "Am. Jour. of Sc.," Feb.—An article describing experiments with Crookes tubes through which continuous wires are passed and in which there is therefore no discharge in the usual sense; it was discovered that X-rays were given off from every element of this conductor at right angles to its circuit when a disruptive discharge occurred in the circuit; this was obtained by means of the very high E. M. F. obtained from a Planté rheostatic machine and 10,000 storage batteries. Their conclusions are that such a tube is well suited for studying electric lines of induction; that the direction of the so-called X-rays and cathode rays can be changed by electric induction; that the so-called X-ray burn can be produced by an intense state of electrification; that the so-called cathode and X-rays are given off from every element of a continuous conductor at a high stage of the vacuum, both when it is the cathode or the anode of the electrical circuit. They suggest the term electric rays or rays of polarization as preferable to cathode and X-rays.

HEAT PRODUCED BY RONTGEN RAYS. Dorn. "Wied. Ann.," 63, p. 160; noticed briefly in the "Am. Jour. of Sc.," Feb.—He believes to have detected an effect of heat produced by these rays; he used the Toepler method of measuring, the equivalent heat being obtained by an electric current.

EFFECT OF CATHODE RAYS ON AIR. Lenard. "Wied. Ann.," 63, p. 253; noticed briefly in the "Am. Jour. of Sc.," Feb.—He shows that these rays form regions of mist condensation far more powerfully than X-rays do.

ARC BETWEEN ALUMINUM ELECTRODES. Lang. "Wied. Ann.," 63, p. 191; noticed briefly in the "Am. Jour. of Sc.," Feb.—An investigation of the polarization of electrodes of the arc, in which he finds that a steady current is obtained from an alternating one in an arc between an aluminum and a carbon terminal, the direct current amounting to about 6 per cent. of the alternating one and flowing from the positive aluminum to the negative carbon, which is the reverse of that in an electrolytic cell with an electrode of aluminum and the other of another metal.

ELECTRIC WIND. Arrhenius. "Weid. Ann.," 63, p. 305; noticed briefly in the "Am. Jour. of Sc.," Feb.—He describes experiments which support the view that the so-called electric wind is due to an electrification of the surrounding medium which separates the molecules into ions which then repel one another; he found that the repulsion was proportional to the gas density; the experiments therefore support the ion theory rather than the dust theory. This does not agree with the results obtained by Warburg, who found that dry air free from dust cannot be electrified and that in damp air charges are carried by the water.

TEMPERING MAGNETS. Barus. "Terrestrial Magnetism," March, 1897.—Extracts from a Bulletin of the U. S. Geol. Survey, No. 14, 1885, giving the results obtained by him and Strouhal on the effect of hardness on the electrical and magnetic constants of steel, with special reference to the tempering of magnets. A number of the curves of experimental results are produced. The following conclusions regarding practical treatment of magnets in which permanence is the chief object, are given; glass hard tempered rods should not be used; after a uniform glass hardening a rod should be exposed for a long time, 20 to 30 hours or more, to steam at 100° which will give the maximum permanent hardness for that temperature; they should be subjected to the same treatment for about five hours after magnetization to saturation; the permanence against effects of temperature, time and percussion is probably then the highest conveniently obtainable.

VERTICAL EARTH AIR ELECTRICAL CURRENTS. Bauer. "Terrestrial Magnetism," March, 1897.—A reprint of a paper describing investigations which seem to show that an appreciable part of the earth's magnetism can be referred to an effect similar to that of vertical earth electrical currents, the average intensity of which between 60 N and 60 S is about one-tenth of an ampere per sq. km. It appears that the downward current corresponds to an increase in the length of the magnetic disturbance vector and vice versa.

SECULAR VARIATION OF THE EARTH'S MAGNETISM IN THE U. S. Shott. "Terrestrial Magnetism," March, 1897.—An appendix of a Government report in 1895, accompanied by diagrams.

DISTRIBUTION OF MAGNETIC OBSERVATORIES OVER THE GLOBE. Schmidt. "Terrestrial Magnetism," March, 1897.—A translation in part of an article from the German, recommending more observatories and a better compilation of the observations.

MAGNETIC OBSERVATIONS AT HIGH ALTITUDES. Preston. "Terrestrial Magnetism," March, 1897.—An abstract of a government report on observations made in the Hawaiian Islands in 1892.

MAGNETIC OBSERVATIONS IN GREENLAND. Putnam. "Terrestrial Magnetism," March, 1897.—A short article giving the results of observations made on the 1896 expedition of Peary.

MAGNETIC EFFECT AT THE KEW OBSERVATORY. Chres. "Terrestrial Magnetism," March, 1897.—A reprint of an authoritative report, followed by a list of the recent papers published in connection with this observatory.

INTERNATIONAL MAGNETIC CONGRESS. Schuster. "Terrestrial Magnetism," March, 1897.—He recommends that a congress be held in 1899 instead of 1900 and points out the necessity of such a congress in connection with work on terrestrial magnetism.

Electro-Chemistry and Batteries.

THEORY OF POLARIZATION. Oberbeck. "Wied. Ann.," No. 13; abstracted in the Lond. "Elec.," Jan. 21.—Streintz concluded that the determination of the galvanic polarization in the original circuits is an impossibility, even when alternating currents are used. The present writer shows that the actual polarizing may be closely approached in several ways; there are two limiting cases, one with very strong and one with very weak currents; with the latter the cell behaves like a condenser, or rather like two condensers in series; the capacity may be regarded as some function of the polarization; it becomes infinite when a certain maximum polarizing force is reached, after which it behaves like a constant cell opposed to the main current; an experimental determination of all the quantities involved may be made with his equation. The question of spontaneous depolarization is yet insufficiently understood, meaning by that term that a portion of the polarizing ions become ineffective in time.

ACTIVITY OF ELECTROLYTIC GASES. Winteler. "Zeit. f. Elektrochemie," Jan. 20.—A short article, in which he claims that there is no foundation for the general belief that hydrogen, oxygen, and chlorine produced electrolytically are more active than the same gases produced chemically; nor is there a reason for assuming a modification of these gases under those circumstances. He also remarks that in gas voltameters incorrect results will be obtained, due to the absorption of the gases by the electrodes; also due to the fact that oxygen is dissolved in the liquid by which it is transmitted to the cathode, where it is again reduced.

CHANGE OF CONCENTRATION BY ELECTROLYSIS. Kohlrauch. "Wied. Ann.," 62, p. 209; noticed briefly in the "Zeit. f. Elektrochemie," Jan. 20.—If a solution is the same throughout the migration of ions will not change it, but if it is different in different parts, a changing of the concentration will be produced; in a mixture of different electrolytes this will take place when the migration relation of the ions depends on the concentration. This is discussed mathematically and laws are deduced.

RELATIONS BETWEEN CHEMICAL AND ELECTRICAL ENERGY. Klaudy. "Zeit. fuer. Elek.," Jan. 9.—A brief abstract of a recent paper; it is a theoretical discussion.

ELECTROLYTIC DECOMPOSITION OF CHLORIDES OF SODIUM AND MAGNESIUM. Beebe. Lond. "Elec.," Jan. 21.—A long abstract of the thesis which was noticed in the

Digest, July 3. It is discussed at some length editorially, and not altogether favorably; it is claimed that a chemical subject is handled without the necessary knowledge of chemistry. It is stated furthermore that the electrolysis of a chloride or bleaching liquor conducted without a diaphragm can be used economically only when the concentration of the hypochlorite is small; a current efficiency of 75 per cent. will be obtained by the use of cool solutions of low concentration; where the bleaching liquor can be circulated and regenerated, or made fresh, from very cheap raw material, there is good hope of a monetary advantage; a distant country having cheap salt and fuel and a heavy freight to be paid on the chloride of lime would be a suitable place for such a method of manufacturing; even in other places the electrolytic process has a reasonable chance of success.

ELECTROLYTIC PREPARATION OF LEAD COMPOUNDS.—"L'Elec.," Jan. 22.—A brief description of the Luckow electrolytic process for making white lead, peroxide of lead, chromate of lead, etc. The process is characterized by the great dilution of the solution, which contains from 1.5 to 2 per cent. in weight of the electrolyte; moreover it contains two different salts in solution, one dissolving the anode and the other for precipitating the desired material; both electrodes are of the same metal; the current is a weak one. A full-page table gives some brief data for seven of these processes.

NEW GALVANIC CELL. Pauling. Lond. "Elec. Eng.," Jan. 21; presumably from the "Jour. of the Chem. Soc.," Jan.—One of the cells described consists of carbon in concentrated chlorine water and carbon in sodium thio-sulphate, the liquids being separated by a porous pot soaked in brine; the E. M. F. on short circuit fell from 0.64 to 0.47, the current being 0.7 amperes; sulphur separates from the sodium solution. In the other cell the electrodes are iron and copper; and the solution is concentrated ferric chloride; the E. M. F. is 0.9 volt; it is cheap and free from odor; it appears that the ferric chloride solution should flow through the cell; it is reconverted by chlorine gas; there will be local action at the iron electrode, due to the carbon which it contains.

TESTS OF DRY CELLS. Knorre. "Elek. Anz.," Jan. 6.—The results of some tests of a certain cell made in Germany.

THEORY OF ACCUMULATORS. Foerster. Lond. "Elec. Eng.," Jan. 21.—A brief abstract of the papers noticed in the *Digest*, July 10.

RISE AND PROGRESS OF ELECTRO-CHEMICAL INDUSTRIES. Swan. Lond. "Elec. Eng.," Jan. 21; begun in Lond. "Elec."—A reprint of his inaugural address as president of the Institution of Electrical Engineers; it appears to be interesting reading. As an appendix he gives a table showing the cost of power for producing 1 pound of the following metals, the electrical horse-power hours consumed in each being given here: aluminum, 14; nickel, 1; sodium, 3.33; caustic soda, 2.33 lb.; bleaching powder, 2.7; chloride of potash, 5; zinc extraction, 1; copper extraction, 0.5; copper refining, 0.25. Regarding the question whether the electro-chemical methods will supersede the chemical ones he states that the answer will be known when information is at hand regarding the details of processes and the operation of raw materials; when the power element is large, its cost is the more important, while in other cases the important item is the raw material. It is discussed editorially in the former journal.

ELECTRO-GALVANIZING. Cowper-Cowles. "Cassier's Mag.," Feb.—After pointing out the disadvantages of the hot method, and the advantages of the electrical one, he gives illustrated descriptions of several plants for electro-galvanizing large plates and tubes; a large number of the British torpedo boat destroyers have been thus coated; large plates can be coated very economically. He obtained a good bright deposit of a solution of 10 ounces of zinc sulphate, and 5 ounces of ferrous sulphate, and a gallon of water, the anodes being of lead and the iron salts brought to the ferric condition, from which no deposit of iron can be obtained; the iron seems to considerably reduce the formation of zinc sponge; a thin coating of zinc, under favorable conditions, is very adhesive; the weight averages 0.75 ounce per square foot; the sand blast is better than acid for cleaning; for more than 1.5 ounces per square foot the coating is not adhesive; some deposits show pin holes, but with the proper current density and strength of solution this can be avoided; the presence of free acid accelerates the condensation of the sponge. A diagram shows the thickness of zinc for withstanding a varying number of immersions in copper sulphate. More metal is taken out than can possibly be dissolved, and he therefore regenerates the solution with zinc dust and heat, this being found to be the only practical method of keeping the electrolyte in working order; this material is considerably cheaper than rolled zinc.

CALCULATION OF THE CONDUCTIVITY OF SOLUTIONS. Archibald. "Trans. of Nova Scotia Inst. of Sc.," Vol. 9; reprinted under separate cover.—A paper on the calculation of the conductivity of aqueous solutions containing the potassium and sodium sulphates. He describes and gives the results of measurements to ascertain whether the conductivity can be calculated in the case of such mixtures, which are more complex than those previously examined; from the results it appears that for mixtures of these salts, concentrated not more than 0.8 equivalent gramme molecules per liter, it is possible with the dissociation theory to calculate the conductivity within the limit of error of observation.

CALCIUM CARBIDE PATENTS. Fraser. "Prog. Age," Feb. 1.—An article on the priority of discovery of a commercial method, the author being the solicitor of patents through whose efforts the Willson patents were procured.

Units, Measurements and Instruments.

APPARATUS FOR MEASURING MAGNETIC FIELDS. Beuger. "Elek. Zeit.," Jan. 20.—An abstract of a recent paper, in which he describes the use of a bismuth spiral for making the magnetic measurements of a sample of iron. Bismuth changes its resistance in a magnetic field; a yoke piece like that in the Hopkinson apparatus has the samples of iron passed through it in the form of two rods with a small opening between their ends, into which the bismuth spiral is introduced, the gap in which it is being constant. When in the magnetic field the bismuth has a different temperature coefficient; a formula for correcting this is given, and within 10° above or below the normal the results will be correct within 1 per cent.

APPARATUS FOR MEASURING LOW RESISTANCES.—Lond. "Elec." and "Elec. Rev.," Jan. 21.—A brief illustrated description of the N. C. S. instrument, which is simple in construction and is useful for measuring dynamo and motor armatures. It has a thick platinum wire 1 metre long and a sliding contact; also a small deflection galvanometer; the fall of potential in the unknown resistance is balanced against that in the platinoid wire.

ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS. Young. Lond. "Elec.," Jan. 21.—The conclusion of the long series of articles which have been running in that journal, and which are taken from a forthcoming book; the first of the series was duly noticed; he describes with diagrams and formulas a very large number of methods of testing used by telegraph engineers.

MEASUREMENT BY SELF-INDUCTION. Guthe. "Am. Jour. of Sc.," Feb.—A short article on a measurement by alternating currents and an electro-dynamometer. He refers to Rowland's recently described methods (see *Digest*, Dec. 18), the principle of which is that if alternating currents of the same period but of different phase traverse the electro-dynamometer, the deflection is proportional to the product of the maximum intensity of the currents multiplied by the cosine of their difference of phase. He experimented with three of the simplest arrangements, two of which were included among Rowland's, but the third is the simplest of all, and has the advantage that it enables small self-inductances to be measured very accurately. Two-phase currents were used, one of which was sent through the stationary and the other through the movable coils of an electro-dynamometer, a balance being obtained by inserting a resistance in series with the stationary coils; the coil whose inductance is to be measured is then placed in series with one of the branches, and resistance added until balance is again obtained; by using a standard induction the increase in resistance necessary to balance a given increase of self-inductance can be determined; for any given frequency, slight variations of which do not appreciably affect the result, the formula is that the self-inductances are directly proportional to the resistances. He believes this method has advantages when the electro-dynamometer has a large self-inductance; the possible errors are small, and the experiment is easily performed.

FLICKER PHOTOMETRY. Tufts. "Prog. Age," Feb. 1.—The conclusion of his long article (see *Digest*, Jan. 29).

Wires, Wiring and Conduits.

WIRELESS TELEGRAPHY. Mattausch. "Zeit. fuer Elek.," Jan. 16.—A short article, in which he suggests the use of a relay in this system of telegraphy by means of Hertzian waves. The receiver is charged by placing the coherer in the primary circuit of a Righi radiator, thus causing it to receive waves from the distant transmitter, and to excite a spark in the secondary coil, thereby making the oscillator belonging to it act precisely like the transmitter in the first station; it will thus receive the signals and transmit them farther, thus enabling the distance of transmission to be doubled, or by repeated relays still farther. A sketch of the arrangement is shown.

VOLTAGE OF TELEPHONE MAGNETOS. Pierard. "L'Elec.," Jan. 22.—A short article, giving the results of some tests made with the magnetos used by the Antwerp Telephone Company. They are made of three permanent magnets; the average resistance is about 500 ohms, the coefficient of self-induction 2.7 henrys when in the same plane with the poles, and 7.3 when perpendicular; the speed is about fifteen turns per second. A curve is given showing the effective voltage for various external non-inductive resistances; the curve is asymptotic to a line representing 65 volts, which therefore is the voltage on open circuit; with 500 ohms it gives 25 volts, and with 2000 ohms 50 volts.

PACIFIC CABLE.—Lond. "Elec. Eng.," Jan. 21.—A reprint of a short article from the London "Times."

TELEGRAPH TROUBLES. Garland. Lond. "Elec. Rev.," Jan. 21.—The first part of an article from the clerk's point of view, which appears to be chiefly of local interest.

TELEPHONE LIGHTING PROTECTOR.—"Elek. Zeit.," Jan. 20.—An illustrated description of one made in Germany.

TELETHERMOMETERS.—"L'Elec.," Jan. 8.—Illustrated descriptions of some forms, based on the change of resistance of wires.

Miscellaneous.

IGNITION OF FIRE DAMP AND COAL DUST. Heise and Thiem. "Elek. Zeit.," Jan. 20.—The conclusion of their last report (see *Digest*, last week). Experiments were made with arc lamps in

an atmosphere of coal dust, in a mixture of this with explosive fire damp, and in explosive mixture; the tests were made with continuous and alternating currents, for both of which the results were the same, and are given in a table; no ignition was produced with the coal dust nor with the second mixture, but the explosive ones were ignited without fail. The results of tests with sparks produced by breaks are given in a large table; an incandescent lamp switch for 4 amperes was safe up to 1 ampere; one for 25 produced ignition at 4 amperes; with induction in circuit the ignition was produced with smaller currents; the switches were opened slowly and fast, with and without self-induction in the circuits; with the alternating currents beter results were obtained by breaking the current slowly; a mercury interrupter for 50 amperes ignited the gases at 1 ampere; in all of the switches or breaks ignition was therefore produced at a fraction of the current for which they were intended; opening a short circuit of an accumulator for 4 to 8 volts was safe up to 20 to 25 amperes. It is therefore not the amount of energy which is cut out of the circuit, nor the current alone which determines the limits, but the voltage, whether produced by ohmic resistance or self-induction; no general rule for such switches can, however, be given. Open fuses are shown to be dangerous. Tests were made with starting resistances, and with overloaded resistance coils; the sparks at the switches of these resistances were so small as not to produce ignition; the heated coils are not dangerous unless brought to a white heat; the incandescence of carbon or copper contacts is not dangerous. Tests were also made with continuous and alternating current motors, and the results are given in a table; the motors had carbon brushes; when the sparking was slight no ignition was produced, but when it was bad, explosions followed. Very good results were obtained with three-phase motors; with these there is no danger unless a brush leaves the contact ring, which can be avoided by having two such brushes. Other researches were made with wires heated to incandescence, and they are found to be relatively safe; they produced ignition when they were melted through; an incandescent coil was also surrounded by coal dust, in order to see whether it would ignite it; the arc formed when it parted produced ignition. A motor was surounded by a wire net of 500 meshes per sq. cm., and when sparking ignited the gas inside, but the flame did not penetrate the wire; the sparks from a gas lighter, 4 mm. in length, produced ignition of illuminating gas at once, but not of fire damp; sparks from a Leyden jar produced ignition when over one-half mm. in length. The results are compared with those made by others previously, and in general were found to agree. In their conclusions they state that these tests should only be used as a foundation for further research; the amount of electrical energy necessary for ignition is exceedingly small, and cannot be determined, as it does not depend on the energy alone; all visible sparks may, however, be considered unsafe; ignition of coal dust, if the mixture is not really dangerous, does not seem to be possible; the bulbs of incandescent lamps should be as large as possible; the leading-in wires should not be in contact when the lamp breaks; the sockets should be carefully made, so that no parts can become loose; high voltage-lamps with two filaments in series are dangerous; the normal current should be below 0.6 amperes; voltage above 150 should be avoided; every lamp should be enclosed in a globe of strong glass; small accumulator lamps must be well protected from breakage; they are safer by far than the usual oil safety lamps, but they do not show the presence of gases; the spark from a single lamp, with a current of not over 0.6 amperes, is not dangerous, provided there is not too much self-induction; with proper precautions, the fixed incandescent lamps may be considered safer than the usual mining lamp; arc lamps cannot be used; the rupture of a cable would surely produce ignition; switches and fuses must not come in contact with the gases, except with small accumulator lamps; short circuits between resistance spirals should not be possible; inflammable insulating materials should not be used; small starting resistances may be used without danger, but switch contacts had better be enclosed; white hot carbon contacts did not produce ignition, provided no arc was formed; magnetic spark extinguishers are, of course, excluded; liquid resistances are dangerous, owing to the spark, when the circuit is broken; small continuous current motors can easily produce ignition, while large ones, in good condition and well attended, even when sparking slightly, are not dangerous, but these conditions are seldom found in mines, and such motors should therefore either not be used or be enclosed; three-phase motors, with two brushes for each contact, are not dangerous, but when switched by hand they produce sparks, and should be excluded.

COUNTING CARS.—"Eng'ing News," Feb. 3.—A note stating that a new device for counting the electric cars crossing the Brooklyn bridge will shortly be tried. At the New York end the trolley wires will have an insulated section of about 60 feet supplied by a tap through an electromagnet, which operates a counter. There will be 3000 to 5000 cars per day, for which a toll of five cents per car is to be paid.

CURING CONSUMPTION.—"El'ty," Feb. 2.—An editorial on the recent discovery of Bleyer. It is not yet thoroughly perfected, but experiments so far have been very successful; a great quantity of current is used and distributed over a large surface, for which reason there is no pain; the system is based on the principle that ozone is generated, which revivifies the blood; a pad is placed directly over the chest, and another on the back; currents of extremely high voltage are sent through the body for half an hour; advanced stages cannot be cured.

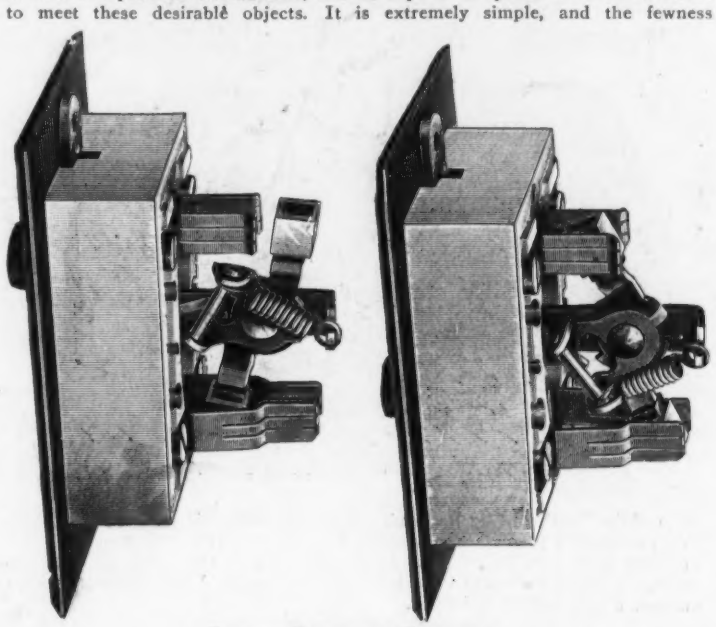
EFFECT OF ELECTRIC CURRENTS ON BUILDINGS.—"Sc. Am. Sup.," Feb. 5.—An abstract of a report to the American Institue of Architects. It is vague and theoretical, and does not appear to contain anything of importance; it is stated that a disturbance of any kind, on the materials of the building "sets up electrical manifestations," and that even the digging of the foundations and the equipping of a building produce such disturbances; it is believed that electric currents so produced are very destructive agents.

NEW METHOD OF INSULATING A CONDUCTOR.—"El'ty," Feb. 2.—An editoral describing a method recently devised by Robertson, which seems to consist in enclosing the conductor in an underground tube of insulated material, from which the air has been exhausted "in the direction of the current" (!); he thinks that such a line will transmit electricity and distance without the slightest loss. (He is evidently not conversant with the laws of electrical resistance.)

Flush Switch of New Design.

Last summer the Newton Appliance Company, 120 Liberty Street, New York, introduced to the trade a flush switch which met with immediate favor. It was so well thought of that it was used in such installations as the Astoria Hotel, Columbia College, Sherry building, Standard Oil building, Delmonico building, the New York City Hall and others in New York City.

The object sought after in turning out this switch was to make a thoroughly reliable and practical flush switch, and no expense is spared in its manufacture to meet these desirable objects. It is extremely simple, and the fewness



SWITCH OPEN AND CLOSED.

of its working parts invariably strikes the observer forcibly. The moving parts are made up entirely of phosphor bronze and brass, and there are no steel springs used in its construction. The advantage of this is apparent. Every contractor is aware that when a flush switch is installed in a new building the plaster is usually wet, and it has to remain for a considerable period of time before it is put into practical use. Where a steel spring is used this is a severe test, it being found that when the switch is required a corrosion of the steel spring has rendered the switch useless. Another marked advantage which this switch possesses is the fact that the leading-in holes through which the wire is passed to the front of the switch where the connections are made are large enough to take an insulated wire. The good points of the switch have been promptly recognized, which fact is demonstrated by the increasing demand.

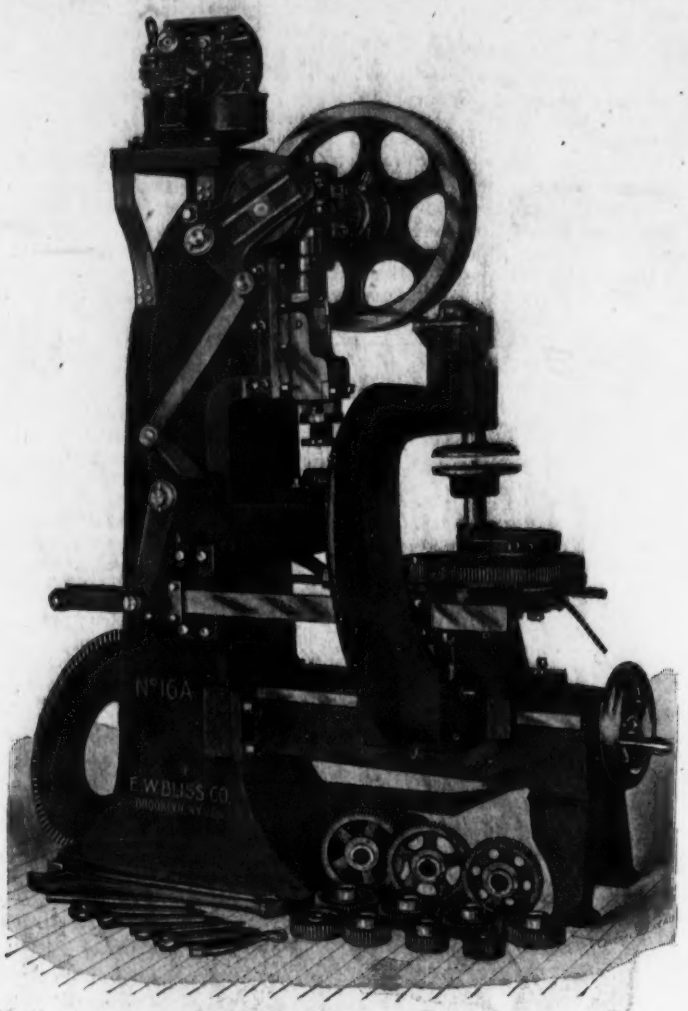
The Largest Railway Generator.

The largest generator for electric traction work ever built is now under construction at the works of the General Electric Company at Schenectady, N. Y. When finished it will be installed at the Logan Street Station of the Louisville Railway Company, Louisville, Ky. On account of its large diameter the armature of this generator cannot be transported over the railroads in its complete state, either erect or on its side. The generator will therefore be assembled in Louisville. The completed machine will have 22 poles, an output of 2400 kilowatts or 3000 horse-power, and will be driven at a speed of seventy-five revolutions per minute by a 4000 horse-power, cross-compound engine, to be furnished by the Allis Company.

The generator will be constructed to stand an overload of about one-third, so that the capacity in case of emergencies may equal 3200 kilowatts or over 4000 horse-power. The principal dimensions of the machine will be as follows: Diameter of field frame, 19 feet; width of field frame, 4 feet 1 inch; diameter of armature, 12 feet 9 inches; diameter of commutator, 9 feet 3 inches; diameter of shaft, 2 feet 3 inches; total weight of armature and commutator, 83,000 pounds; width of armature, 5 feet; width of commutator, 21 inches; total width of generator, 77 inches, and total weight of generator complete, 174,000 pounds.

Previous to the manufacture of this machine the largest generators constructed for electric railway work were those of 16000 kilowatts, or about 2500 horse-power, the first of which was used in the Intramural Power House at the World's

Fair. Dynamos of the same output have since been installed in Philadelphia, Boston and Chicago. Four are also operating in the Kent Avenue Power Station of the Brooklyn City Railroad, and two of similar size are now being added. At present this power house contains the largest single exhibit of moving machinery in Greater New York. In no other city of the State, with the exception of Niagara Falls, can 10,000 horse-power in engines and dynamos be seen in almost constant daily operation.



Armature Notching Press.

New Automatic Armature Disc Notching Press.

The disc notching press illustrated above is manufactured by the E. W. Bliss Company, Brooklyn, N. Y. It is of entirely new design, and is said to offer several important advantages over other machines of this class. By simply turning the hand wheel adjustment for different diameters is effected, and the adjustment of different numbers of notches is accomplished by means of change gears instead of the usual pawl and index plate device. This obvioates the necessity of using a special indexing plate for each style of disc. The same set of gears can, in most cases, be arranged to answer for three different numbers of notches, so that ten change gears, for instance, may be used for thirty different divisions. The index feed is effected by means of a rack and pinion movement, which is claimed to be more reliable and durable than the pawl and ratchet feed usually employed.

An automatic stop is provided, which throws out the clutch as soon as the disc has made one complete revolution. The machine then comes to a stop. To start the machine the operator simply presses the foot treadle; it is possible for one operator to attend to several machines. The spring stripper is used in connection with the punches in this machine, so as to leave a clear space over the die, making it easier to introduce a new disc, and holding the disc under pressure while being punched. In the case of such polyphase motor discs as have the holes or notches punched in the inner periphery it is necessary of course to do the notching before the large inner circle is removed, as its surface is needed for carrying the disc in notching.

In the cases where the clamping of the disc is desirable, machines are furnished with an arm (see illustration) which carries a device enabling the operator by a single movement of the hand lever to do the clamping. This arm connects at its lower end with the frame which carries the mechanism for revolving the disc from notch to notch. The machine illustrated is driven by an electric motor, which may be of any make.

These presses are made in three sizes, the largest disc that can be notched by them being 36 inches, 48 inches and 60 inches respectively. The smallest disc that can be notched is 3 inches. The largest number of notches that may be cut with a single punch in the three machines is 156, 194 and 530, and the smallest number in any one machine is 12.

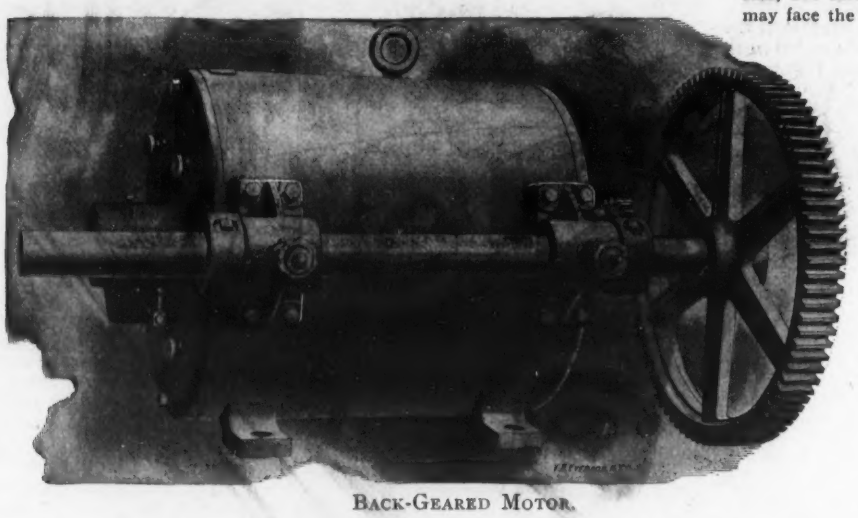
Back-Geared Iron-Clad Motor.

There seems to be a steadily increasing demand for motors of the entirely inclosed type for use in connection with all classes of machinery, especially where the presence of dust, gases or moisture makes the use of a machine of this type not only advisable but almost imperative. These motors have proved the most desirable for use in driving cranes, hoists, elevators, pumps, compressors, sand, coal or ash conveyors, draw-bridges, turn-tables and similar devices, and as the power for such work is generally applied through gearing, a closed type slow-speed motor, carrying a back-geared shaft mounted upon the field frame, is the ideal machine to use in such cases.

The accompanying illustration of the C & C closed type iron-clad motor fitted with back-geared shaft, shows how convenient the form of the motor is for the application of any desired back-geared arrangement. The motor is so arranged that it can be placed in any desired position, and the back shaft bearings can be bolted to the frame at any convenient location. Since the loss due to friction in the gears is comparatively small, and as any desired reduced speed may be given to the back shaft, this method of speed reduction is most economical and cheaper originally than by using a special motor of large size wound down to give a slow speed. To the back shaft either a pulley, gear or coupling may be applied for supplying power to a shaft or machine gearing.

These motors are furnished in all the standard sizes from 5 to 45 horse-power, the initial speeds ranging from 950 revolutions for the former, down to 650 revolutions for the latter.

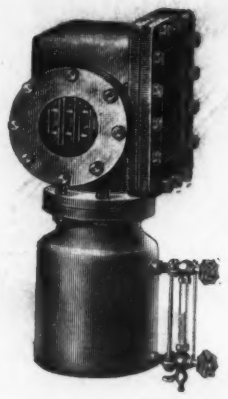
The C & C Electric Company, New York, states that it is receiving a great many orders for equipments of this kind, the majority of them coming from manufacturers of machinery which can be best driven from such an outfit.



Back-Geared Motor.

Steam and Oil Separator with Side Flange.

The importance of frequent cleaning of a separator, especially an oil separator, is as great as that of thorough working—the one is dependent upon the other—and in the matter of making a selection, one should consider carefully this necessity. There are very many places where there is not sufficient head room for the removal of the baffle plates of a separator, and to meet these conditions the A. A. Griffing Iron Company, New York, has produced a separator with side flange through which the baffle plates may be slipped with perfect ease. This separator may be placed so that the side flange may be on either side, but care must be used in placing the baffle plates so that their flat front may face the incoming steam, as this side alone has capillary openings through which the oil and water may enter, and go to the receiver below by the action of gravity. The vertical posts on the rear side of the Bundy separator baffle plate are set staggered with reference to one another, thereby causing the steam to pass through in a zig-zag course.



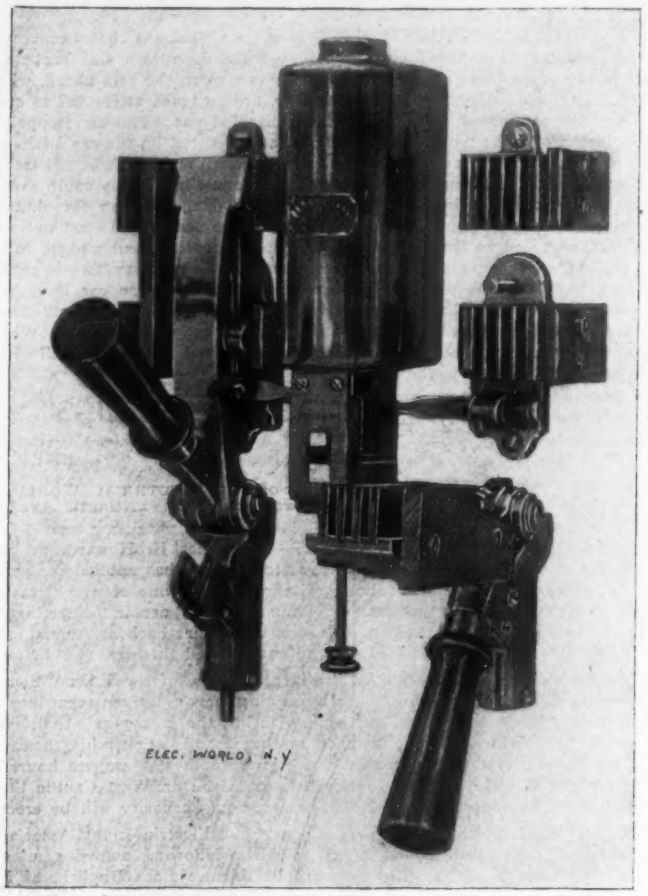
Separator with Side Flange.

The Bundy separator is particularly well adapted for marine use, where, however, the side flange type is almost invariably required. This style is made in all sizes, from 2-inch up to and including 24-inch.

New Type of Circuit Breaker.

The accompanying illustration shows the new type of "DH" circuit breaker manufactured by the Ward Leonard Electric Company, Bronxville, N. Y.

These circuit breakers are so constructed that each side of the circuit in the double pole type is separately closed. The instant the current flows, the side of the switch not held by the operator will automatically fly open and open the circuit if an overload or circuit switch exists. If an overload occurs later, after the operator has left the switch, then both poles will open simultaneously. In both cases the circuit is instantly interrupted, and all the arcing occurs on carbon. The carbon blocks are readily replaced by loosening a couple of screws. The contact blades are detachable by removing one screw, and can be mailed in an ordinary envelope. They are of novel construction, insuring perfect contact, and have a contact duty of fifty amperes of current for each square inch of blade surface. The only adjustment is that of raising or lowering the vertically movable core of the solenoid magnet. The adjustment ranges from 25 per cent. under to 50 per cent. over the current which the circuit



CIRCUIT BREAKER OF NEW DESIGN.

breaker will continuously carry. The adjustment readings cover a long range of travel of the core, and are all well defined and easily read.

This type of circuit breaker is particularly applicable to switchboard work, as all the connections are made at the back. It is said to be reliable in action and easily closed, and its small dimensions constitute a feature which will be appreciated by engineers and station operators.

Electric Floor-Scrubbing Machine.

An ingenious application of electric power is illustrated herewith. The apparatus is an electric floor-scrubbing machine, the invention of Mr. H. F. Ackerman, 226 Hickox Building, Cleveland, Ohio. Mr. Ackerman claims that this machine will do work in one-fourth of the time required in the old way, at a saving of 75 per cent. of the cost. The machine is designed for use in Government, State and large office buildings, hotels, depots, hospitals and halls, department stores, etc. It is operated by an electric motor, which receives its current through a flexible cord connected to any convenient incandescent socket. The reel at the top of the trolley pole takes up the slack cord and unwinds it in the operation of the machine.

The frame carries three scrubbing brushes, which are pressed against the floor with a spring pressure. The brushes are geared with the motor so as to revolve at a speed of about 400 r. p. m. The gearing between the motor and the brushes is by means of a sprocket chain, leading from the motor to the axle, on which the larger wheels loosely revolve, and from that axle by another sprocket chain to a shaft connected by bevel gears with vertical shafts to which the brushes are attached. This permits of the machine being used as a hand machine in case no electric current is available to operate it by electric power. For the scrubbing brushes, sandpaper blocks or blocks of stone may be substituted, and thus the machine may be used to dress down wood floors or mosaic. The springs always keep the brushes in proper contact with the floor. A suitable rheostat or governing device is provided on the handle, and the motor is fully protected by fuses. The machine weighs about 300 pounds, and its frame is about 30 inches square.

These machines have been in actual use in various buildings, in one instance doing work on eight floors in two and one-half hours, which previously required ten and one-half hours to perform by hand. The three brushes are

ELECTRIC SCRUBBING MACHINE.

so arranged in relation to one another that the short axis of the middle one is always parallel with the longer axis of the side brushes, and vice versa. Hence, in operation, the machine scrubs a path as wide as the distance between the outer ends of the side brushes, when they stand end to end, as shown in the illustration.

An English Lamp of New Design.

An incandescent lamp of unique design is one of the novelties in the English electric lighting trade. The accompanying illustration represents it to be nearly ellipsoidal in shape, with its shortest axis on the vertical line. The upper half of the bulb is silvered, for the purpose of reflecting the light in a downward direction, thus increasing the luminosity of the lamp.

It is stated that this lamp has a downward lighting efficiency 100 per cent. greater than that of the ordinary form of lamp. Dr. John Hopkinson made some tests upon it, comparing it with the common pear-shape lamp. He

AN ENGLISH FANCY.

found that the average candle-power over the lower half of the globe of the new lamp was 38.6, while in the ordinary Edison lamp, with equal current, it was only 12.3. The relative consumption of current per candle was also determined. Along the axis of the new lamp he found the consumption to be 0.9 watts per candle, and in the Edison lamp it was 3.65. From a little calculation it appears that the comparative cost of lighting for 1000 hours between the two styles of lamps, the improved lamp being of eight candle-power and the ordinary lamp of sixteen candle-power, is greatly in favor of the former.

The Improved Electric Glow Lamp Company, Limited, London, England, is exploiting the new lamp.

News of the Week

Financial Intelligence.

THE ERIE TELEGRAPH & TELEPHONE COMPANY has declared a quarterly dividend of 1 per cent., payable February 14.

THE ANNUAL REPORT of the Edison Electric Illuminating Company, of Boston, for the year ended December 31, 1897, shows the following results, compared with the previous year's statement: Gross earnings, $879,949, an increase of $106,471; net income, $339,828, an increase of $64,648. The company has 158,283 incandescent lamps connected to its system, 1549 arc lamps and 6145 motors. In the report for 1896, the figures representing the last three items were 134,380, 1422 and 5354, respectively.

Special Correspondence.

New York Notes.

Office of The Electrical World,
258 Broadway, New York, Feb. 7, 1898.

MR. MAX OSTERBERG has been retained by the Electrical Exhibition Company as construction engineer.

MR. R. C. FOSTER, manager of the Cornman Company, dealers in electrical apparatus, Cleveland, Ohio, was in New York on business during the past week.

MR. CHARLES K. KING, secretary of the Ohio Brass Company, Mansfield, Ohio, was a visitor in New York last week. The business of the Ohio Brass Company, particularly in the overhead railway equipment line showed a marked increase last year, and Mr. King, Mr. Black and Mr. Berg are correspondingly pleased thereat.

MR. J. M. HILLS, Western manager of the Bryan-Marsh Company, has been in New York for several days. Mr. Hills is the officially appointed representative of the Northwestern Electrical Association to arrange for a unique feature for the convention of the association next June. This is to consist of an excursion for several days by steamship to Duluth, the convention leaving Chicago June 11.

MR. MICHAEL R. BRENNAN has been appointed superintendent of the new police telegraph bureau of New York City, which bureau has just been instituted under the Greater New York charter. Mr. Edward H. Murphy was appointed assistant superintendent. Mr. Frank C. Mason also received the appointment of assistant, and will have charge of the service in the Borough of Brooklyn. The superintendent was instructed to prepare plans for the extension of the telegraph service in the different boroughs of the city.

IMPORTED ELECTRIC LIGHT CARBONS.—On February 1 the Board of General Appraisers heard a protest from several electric light carbon importing houses respecting the duty on imported electric light carbons. The firms interested were Hugo Reisinger, Schiff, Jordan & Co., Machado & Roller and others. They declared that the local appraiser's interpretation of the new tariff law relating to imported carbons practically prohibits such importations. Decision was reserved pending an investigation into the matter by the Government.

ELECTRIC POWER ON THE ERIE CANAL.—The stockholders of the Erie Canal Traction Company held a meeting at 32 Nassau Street, in this city, on February 3. Baron von Hoffman was elected president, Frank W. Hawley vice-president and Charlton T. Lewis secretary and treasurer. It is stated that the Walker Company has submitted to the company a plan for a system of electric canal boat propulsion which is regarded with favor. The Erie Canal Traction Company has the exclusive right to equip the canals of the State with a system of electrical propulsion. Its capital stock is $5,000,000.

PROFESSOR SHORT'S EXHIBIT AT THE ELECTRICAL EXPOSITION.—Professor S. H. Short, of the Walker Company, will make a personal exhibit at the Electrical Exhibition, which will be held at Madison Square Garden next May. For some fifteen years he has been actively engaged in railway design and invention. On the occasion of the exhibition his work in this direction will be illustrated by pictures, relics, models, old apparatus, etc. This exhibit will be additional to that of the Walker Company, which will make an excellent display of its modern apparatus for the generation and distribution of electric power.

RECEIVER FOR THE HUDSON TELEPHONE COMPANY.—About one year ago the Hudson Telephone Company was organized in Jersey City, N. J., with a capital of $300,000. Thursday last application was made for the appointment of a receiver for the company. The principal mover in this action is Thomas Hill and twenty-five other stockholders. According to the bill of complaint the Hudson Telephone Company was to pay certain royalties for the use of transmitter and receiver patents held by the Best Telephone Company, which royalties, it is alleged, are excessive. The bill prays that the contract between the companies be brought into court for review. It is further alleged that the Hudson Telephone Company awarded the contract for the construction of its lines without previous advertising according to law. Several heavy judgments are pending against the company, it is also alleged, and that it is practically insolvent. Manager G. H. Atkinson, on the other hand, claims that the concern is perfectly solvent, but that some of the stockholders are entirely unreasonable in their expectations.

IN COMPLIANCE with the request of the Board of Rapid Transit Commissioners, the Manhattan Railway Company, on January 31, through President George Gould, filed a formal application for permission to build extensions and make improvements to the elevated railways of this city, as outlined in the last issue of The Electrical World. Beside asking for extensions of the present routes downtown, so as to reach the New Jersey ferries, and providing for a crosstown line through Canal and Centre Streets to the City Hall station, the railway company has met the expressed views of the commissioners by extending its proposed west side route to Kingsbridge, instead of stopping it at Fort George. The application seeks permission to build additional tracks and station facilities upon the existing lines. The plan is to virtually four-track each of the four trunk lines now existing, and it is proposed to do the greater part of the work within two years. A letter from Mr. Gould, which accompanies the application, indicates that the railway company is willing to do everything that is reasonable to meet the public demand for rapid transit.

A CABLE TRACTION ACCIDENT.—About 1 o'clock on the afternoon of February 5 a strand of the Broadway cable on the downtown side broke and caught in the grip of one of the cars. Word was sent to the cars ahead, which gripped the cable tightly to get out of the way, until a truck attempted to cross in front of the car immediately ahead of the disabled one. The car stopped to avoid collision with the truck, and was struck at full speed by the car following. Both cars rose in the air and fell across both the north and south bound tracks, dragging for some feet sideways on the paving stones, before the cable parted. Fortunately no one was injured, the most serious damage being the shutting down of the Broadway line for several hours. It was necessary to cut out with cold chisels and sledges the grips which had become twisted and wedged in the cable slot. The Metropolitan Company operating the Broadway line is rapidly extending its electric service, and as soon as the main horse car lines have been re-equipped will probably change over its cable service. Five hundred cars have been recently ordered for use on the lines recently constructed. Within six months' time the horse cars will have been removed from almost all of the main streets and avenues of the city.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Feb. 5, 1898.

REVOLVING CYLINDRICAL SAFES.—Mr. James H. Howard, 106 Sudbury Street, Boston, consulting engineer, states that he has applied for patent rights on the general idea of revolving cylindrical safes, one of which was described in The Electrical World of January 15, for use in protecting the tabernacle in a church in Brooklyn. He says that as far back as August, 1896, the Carnegie Steel Company examined and commended them.

IN THE ANNUAL REPORT of President Rogers, of the Edison Electric Illuminating Company of Boston, some interesting facts are given regarding the use of storage batteries by that company. During the past year a battery of 4000 ampere hours capacity was installed in the second station, while the capacity of the battery at the third station was increased to 5600 ampere hours, or about 75 per cent. The company purchased some land on West Canton Street on which a storage battery plant of 4800 ampere-hours capacity will be erected.

THE ANNUAL MEETING of the Connecticut Electric Light Association was held in New Haven on January 31, and the following named gentlemen were elected officers for the ensuing year: President, James English, of New Haven; first vice-president, C. A. Learned, of Meriden; second vice-president, C. H. Nettleton, of Derby; treasurer, A. M. Young, of Waterbury; secretary, Addison F. Hunie, of New Haven. After the meeting a dinner was served at Traeger's. There were eighteen gentlemen present representing the electric light companies of the State. The meeting was a very enjoyable one. Matters of minor importance were discussed informally, the election of officers being really the only business transacted.

MR. H. C. THOMSON, who for a number of years has been prominently identified with the Electric Gas Lighting Company of Boston as special traveling representative, and for a year past as one of its active office executives, has just been elected manager of the company. This is a tribute to tireless energy, rightly earned and thoroughly deserved. Mr. Thomson possesses a thorough knowledge of the electrical business, and quite a few of the company's specialties are the result of his inventive mind. He is an incessant worker, and possesses business qualities calculated to win success. The Electric Gas Lighting Company can boast of a strong business combination in its general secretary and treasurer, Mr. A. Drew and Mr. Thomson.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY has purchased a piece of property on Oxford Street, running through to Oxford Place, and will at once erect an exchange building thereon. This improvement was rendered necessary on account of the rapid increase in the number of subscribers. When this exchange is completed it will take in the district south and west of Summer Street, now in the Boston Exchange district, and also a part of the Tremont Exchange district. Upon the completion of the new exchange the name "Boston," as distinctive of a district, will be abandoned, as it is considered a misnomer and a name more distinctive will be chosen. The district to take the place of the Boston Exchange will take in all subscribers from State Street to Summer Street.

MESSRS. G. M. ANGIER & CO., 64 Federal Street, Boston, now have the control of the entire output of the well-known Paragon arc lamps, adaptable to direct arc, direct incandescent of alternating circuits, for inside and outside service. These lamps have already acquired good sales, and an enviable reputation for excellent efficiency, and in important comparative tests have sustained the claims made for them, showing superiority in some tests. A new lamp will soon be introduced which, it is claimed, will win even greater commendation. The Paragon Arc Lamp Company is to be congratulated over having made a business connection with such a reputable and strong firm as that of G. M.

Angier & Co., a firm widely known because of its excellent business reputation, straightforwardness and reliability in all its transactions. Mr. G. M. Angier has had long and creditable service in the electrical business, personally enjoys the high regard and esteem of a large circle of friends, and possesses about all the requisites necessary for the success he has achieved, and as sole selling agent for the Paragon arc lamps, he will undoubtedly secure for them increased sales and recognition. Mr. F. B. Smith, formerly general manager of the Paragon Arc Lamp Company, is associated with Mr. Angier, and will continue in close contact with the trade, winning from it even greater orders than ever for Paragon arc lamps, the virtue and mechanism of which he is thoroughly familiar with, even to the minutest details. Mr. Smith has also a strong following because of his genial and happy nature and disposition.

DISASTROUS STORM.—A snowstorm began in this city on the morning of Monday last, January 31, and continued until a late hour in the afternoon of Tuesday. It was the most severe storm on record, and did a great deal of damage to overhead wires, and caused a complete suspension of electric railway traffic. For about eighteen hours Boston was cut off from all communication with the outside world and paralyzed, all telegraph and telephone wires being prostrated and all trains and electric cars stalled. About 18 inches of snow fell, and hundreds of miles of wire were carried down by the weight of the snow. The streets in many places were literally covered with a network of tangled wires, and in the darkness which prevailed on Monday night on account of the cutting off of electric light current, it was extremely dangerous to pass along the streets. Even the subway was practically deserted from midnight Monday till noon on Tuesday, and after that time the cars ran into it only very infrequently. The fire alarm wires were also badly crippled. Owing to the dangers of the falling wires Mayor Quincy ordered the current to be cut off from all electric light wires on Monday night, except those underground, and for this reason the city was in darkness, except an area in the very centre, about a mile square. Very few of the suburban cities had any lights on account of the damage done to the lines and the necessary shutting off of current. General Bancroft, of the Boston Elevated Company, which now operates the entire street railway system of this city, stated that the storm will cost his company alone over $1,000,000. It had 7000 men and more than 1000 teams at work clearing the tracks. The tie-up of telephone and telegraph wires was practically complete; not a wire of any sort was working out of Boston at 10 A. M. on Tuesday. Worcester was the most easterly point reached by New York wires. New York dispatches from Boston were sent to Worcester by train, and put on the wires at the latter place. At Providence the fall of snow was very heavy, and telegraph and telephone wires were strewn all over the ground and on the railroad tracks, rendering travel on the steam roads very difficult and dangerous. Electric light wires were prostrated all over the city, and the current was necessarily shut off. Not only did the wires come down, but the poles as well, and the wreckage in the streets was an inextricable tangle of broken poles and wires. Electric cars were stalled all over the city. There was not a single street car running in the entire State of Rhode Island on the morning of Tuesday. The loss to the telephone and telegraph companies will be enormous all over the State. The buildings in this city after the storm presented a remarkable appearance. The snow was very moist, and, driven by the furious wind, stuck to the buildings and covered them with a winding sheet many inches thick. On Thursday the New England Telephone & Telegraph Company had only six wires beyond 10 miles to Boston. These reached Springfield, Lowell, Greenfield and Worcester. The company expected to have New York wires ready for public use on the same day. On Thursday the Postal Telegraph Company had two New York wires, and accepted messages subject to delay of one hour. The Western Union also had communication with New York, but business was received subject to indefinite delay. The Long-Distance Telephone Company suffered a great deal of damage by the breaking down of its poles. To dig holes and put up new ones was out of the question, and the company decided to reach Boston by laying an emergency cable. This cable carried fifteen wires, and was so heavily insulated that it was laid on the ground wherever the poles were broken down. In some cases it was laid along fences and walls. The storm furnishes fresh ammunition for the undergrounding of all wires, and presumably electrical interests will be kept busy during the present session of the Massachusetts Legislature.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Feb. 5, 1898.

THE NEW WHEEL PIT at the Niagara Tunnel is finished and the bulkhead removed, so that work on the erection on the turbines can proceed at once. It is promised that the fourth generator of 5000 horse-power capacity shall be in position this month. After that it ought to be easy to keep ahead of the demand, as the extended wheel pit now has a capacity for machinery that will generate 50,000 horse-power.

THE BUFFALO TRACTION COMPANY has this week added two lines to its service, and is running twenty cars, all that it has. About 17 miles of lines is now operated, most of it single track, but on loops by which the cars go out one street and return on the next. Ten new cars have been ordered, but no further extension will be made till spring. Already the old company has increased its service in the new district, so that the east side will soon be well traversed by cars.

THE MEETING OF THE STOCKHOLDERS of the Buffalo General Electric Company has resulted in the narrowing down of the choice of a central city station for the lighting plant to two localities, with the old Wilkeson Street Station likely to be taken. There was some inclination in favor of a site two or three blocks east of Main Street as a good location for distributing power as well as light, but the final disposition of the matter was left to a committee to make a choice within ten days. At all events the present headquarters on Court street will be abandoned. These changes, when effected, will revolutionize the work of electric lighting and power distribution over the city.

TONAWANDA HAS VOTED to renew its contract with the lighting company, and give up the idea of erecting its own plant. The decision was apparently reached through the showing made by a report to the company by Mr Horatio A. Foster, the electrical engineer, who has gathered statistics on the spot from every electric railway, light station, messenger call and fire alarm system in the State. The company offered the corporation 130 arc lamps at .0195 per lamp per hour, and Mr. Foster shows from figures obtained from the municipal plants in Batavia, Dunkirk and Jamestown that the offer is more favorable than anything likely to be obtained of a plant erected and run by the corporation, as Batavia, by his figures, pays .0204, Jamestown .0213 and Dunkirk .0251 per light per hour. Mr. Foster claims that city management of such plants fails principally from the system of frequent change of officials, all of whom are eager to make a showing of cheapness, and invariably order the engineer in charge to run cheaper than he has ever done before. In this way the plant is early ruined through want of repairs, and soon must be rebuilt.

PITTSBURG NOTES.

PITTSBURG, Pa., Feb. 4, 1898.

MESSRS. FOWLER & CO., who are interested in the electric lighting of Malaga, Spain, have ordered from the Westinghouse Electric & Manufacturing Company two sets of electric light plants, each of 125-kw capacity. They are now on the way to Malaga.

ELECTRIC LIGHT PLANT FOR THE WESTERN PENITENTIARY.—The board of inspectors of the Western Penitentiary of Pennsylvania have approved the plans and specifications drawn up for the proposed electric light for the penitentiary, and will receive proposals until February 17, for furnishing apparatus and material.

NEW TELEPHONE COMPANY IN OHIO.—The County Commissioners of Carroll County, Ohio, have granted a franchise to the Carroll County Telephone Company. The purpose of the company is to connect all the towns in the county, and extend their lines to Steubenville and Canton. Headquarters will be at Carrollton, and the line is expected to be in operation in May.

IRWIN AND McKEESPORT TO BE CONNECTED BY TROLLEY.—The announcement is made that a direct trolley line between Irwin and McKeesport will be in operation by July 1. The rights of way required have been obtained for the entire distance, which is about 6½ miles. At McKeesport the new road will connect with the United Traction Company's lines running into Pittsburg. Mr. John George, of Irwin, is president of the proposed road, and Mr. C. R. Fritchman, of Irwin, is secretary and treasurer.

ELECTRICAL APPARATUS FOR THE CHILKOOT PASS.—The Westinghouse Electrical & Manufacturing Company has just shipped from its works at East Pittsburg a lot of apparatus to be used in the operation of the wire tramways in Chilkoot Pass. The shipment includes one 45-kw two-phase generator, with exciter and switchboard, two 25-kw raising transformers, four 10-kw step-down transformers, one 15-hp motor and one 30-hp motor. The power plant will be located near the coast, the generator being driven by steam. The power will be transmitted at a pressure of 5000 volts, 13 miles to Chilkoot Pass.

HOME TELEPHONE COMPANY REORGANIZED.—The Home Telephone Company has been reorganized, and it is stated that the control of the company is now, and will remain, in the hands of citizens of Pittsburg and Allegheny. A circular letter has been sent to all members of Allegheny Councils soliciting co-operation in securing the passage of anordinance granting franchises to the company. The names signed to this circular as directors in the company are Lee S. Smith, William Pickersgill, Jr., H. A. Spangler, Harry G. Samson, of Allegheny; and Hudson Sampson, Smith Agnew and John Murphy, of Pittsburg.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 5, 1898.

MAJOR ARTHUR B. FOSTER, of the Cleveland Greys and president of the Cleveland Electric Supply Company, of Cleveland, Ohio, was a visitor in Chicago last week.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, was in Chicago last week. Mr. Thresher says his factory is now running night and day, in fact business has become so brisk, and the demand for his machines so great, that it has become necessary to increase the capacity of his factory.

THE CHICAGO TELEPHONE COMPANY has filed a bill in the Superior Court to restrain John Ernst, Collector of the South Town, from collecting an alleged excessive tax on the property of the company. The bill sets forth that the company received notice from the assessor to the effect that the assessment on its personal property would be $250,000. The company states that it has since received notice from the collector that its assessment had been increased by the State Board of Equalization to $334,800, making the amount of tax due $31,226,89. The company declares that it is willing to pay under the original assessment of $250,000, which would make the tax, as equalized by the State Board, $29,214.20. The court is asked to enjoin the collector from exacting any more than that amount or from interfering with the property or business of the complainant in default of the amount demanded.

MILWAUKEE NOTES.

MILWAUKEE, Wis., Feb. 4, 1898.

THE CITIZENS' TRACTION COMPANY, of Oshkosh, has been granted a franchise for an extension of his system on the South Side.

MR. F. S. COMSTOCK, of Chicago, has applied to the Kenosha Council for Kenosha Council for a franchise to build a street electric railway.

THE VIROQUA TELEPHONE COMPANY recently gave a concert over its wires, which cover a large part of Southwestern Wisconsin. All the circuits were connected to the concert circuit.

THE EASTERN WISCONSIN TELEPHONE COMPANY, which has been incorporated by citizens of Elkhart Lake, has purchased the new lines of the

Sheboygan & Manitowoc Telephone Company. The new company will extend the lines to a number of cities in Fond du Lac and Calumet Counties.

THE NORTHWESTERN WISCONSIN TELEPHONE COMPANY has made application to the City Council of Green Bay for permission to build its line into the city. The company is the successor of the North Wisconsin Telephone Company, which failed last fall. The company is located in Echawano County, and its Eastern terminus is Angelica, from which place the line would be extended to Green Bay.

THE STOCKHOLDERS of the Milwaukee & Waukesha Electric Railway Company have elected new directors. The company is the predecessor of the Citizens Traction Company. In 1896 the common council granted the Citizens Traction Company a franchise to operate an electric railway in this city in opposition to the Milwaukee Electric Railway & Light Company. So far very little has been done, although a few feet of track has been constructed. Inasmuch as this company did not comply with the franchise, the new company is trying to revive the franchise. The new directors are: John A. Kenney, of New York; E. H. Bottum, C. L. Gross, Frank Koehler, S. I. Henderson and C. E. Wild.

St. Louis Notes.

St. Louis, Mo., Feb. 4, 1898.

THE CITIZENS' ELECTRIC LIGHT & POWER COMPANY filed an application for an increase of capital stock from $750,000 to $2,000,000, $1,250,000 paid up. The liabilities are placed at $750,000. It is supposed that the Citizens will be among the bidders for the new lighting contract.

FIFTIETH ANNIVERSARY OF THE TELEGRAPH IN ST. LOUIS.—February, 1848, the telegraph was first introduced into St. Louis, and it is the intention of the St. Louis Telegraph Club to appropriately celebrate the event this month. A committee has been appointed to make arrangements.

THE FORMAL TRANSFER of the personality of the St. Louis Electric Light Company was made to the Missouri-Edison Electric Lighting Company, Tuesday, February 1, and the former ceased to exist in name, as it did in fact same time ago. The absorption of the St. Louis Company removes the last competitor from the electric lighting field in St. Louis. The Missouri-Edison Company now has an absolute monopoly.

Colorado Note.

Denver, Col., Feb. 4, 1898.

DENVER CABLE RAILWAY TO BE ELECTRICALLY EQUIPPED.—If plans which are now practically decided upon are carried out a large addition will be made to the electric railway mileage of Denver, Col. The Denver City Railway Company proposes to abandon the cable system and to substitute the trolley system. The street railway system of Denver is controlled by two companies—the Denver Tramway Company, whose lines are electrically operated, and the Denver City Railway Company, which has continued to use the cable for operating its cars. The latter operates the following important lines: Sixteenth Street and Seventeenth Avenue line, Seventeenth Street and Seventeenth Avenue line, West Denver line and Welton Street line. The cable company's tracks occupy the two principal business streets of the city, Sixteenth Street and Seventeenth Street. There have been rumors in circulation heretofore that the present system of operation was to be abandoned for reasons of economy, but up to the present time they have been premature. The management now states that the change will doubtless be made, although no details are yet given out for publication. The company, it was stated, was not yet ready to consider any propositions in connection with the change in motive power. As yet, indeed, the company has not secured from the city a franchise enabling it to make the substitution. It is understood that an ordinance has been prepared, and will shortly be introduced in the City Council, and it is thought that little difficulty will be encountered in obtaining the necessary privilege. The trolley system is more popular in Denver than the cable, and it is thought that the cable company's application to substitute the former for the latter will be strongly endorsed by public opinion. In asking for the right to change the motive power the cable company does not propose to petition for any franchise for extensions, except such as will enable it to build loops at the termini to make unnecessary the switches which are now in use at these points. The company, it is stated, will also ask for a franchise to equip as an electric line the present horse railway which connects the north end of the Sixteenth Street viaduct to the town of Argo, where the great smelters are located. The scheme of equipping the system will involve the remodeling of the power house of the company and its equipment as an electric generating station. Before the work is completed the company will beyond a doubt expend a very considerable sum of money. The manager of the company is Mr. E. C. Baggs, and his office is located at the power station, Eighteenth and Lawrence Streets, Denver.

Mexican Notes.

Monterey, Mexico, Jan. 31, 1898.

THE RAILROADS OF MEXICO have filed a strong protest with the Mexican Government against the contract recently entered into between the Western Union Telegraph Company, the Federal Telegraph Company and the Federal Government, giving the Western Union exclusive control of the international commercial telegraph business of Mexico. The railroads claim that this contract is a violation of their respective concessions. The Western Union service in Mexico was to begin on January 5, but was postponed pending a decision of the Government. This contract was referred to in this correspondence, published in The Electrical World of January 8 last.

EX-GOVERNOR W. T. THORNTON, of New Mexico, one of the wealthiest citizens of that Territory, has been in the city of Mexico for the past few weeks for the purpose of examining into the possibilities of securing water power in that locality, where he proposes to erect a large plant for the transmission of electricity to the city of Mexico. He is accompanied by Col. W. E. Cutshaw, city engineer of Richmond, Va. Governor Thornton states that a number of prominent electricians and capitalists of the United States are associated with him in the enterprise. They propose to build a large plant at the point selected to generate electricity, and another plant in the city to distribute it. Their plan is to furnish power to street railway companies, electric light plants and manufacturing concerns. It is stated that at the present time there is used about 7000 horse-power in the city of Mexico, and its cost is about $200 per year per horse-power. The high cost of power is caused by the high price of fuel. Governor Thornton and Colonel Cutshaw have examined the water power afforded by the Amacusac River, near the mining town of Huatla, a distance of 65 miles from the city; another near San Gabriel and others in the neighborhood of Jojutla, Tetecala and Toluca. They propose to erect a plant with a capacity of 40,000 horse-power. As soon as the plans of the promoters of the enterprise are far enough advanced the Mexican Government will be asked for a concession, under the terms of which the machinery for the plant will be admitted to this country free of duty and the concern exempted from taxation for a term of years.

Texas Note.

San Antonio, Texas, Jan. 31, 1898

THE FORMAL TRANSFER of the Queen City Street Railroad, an important electric line of Dallas, Tex., to C. H. Alexander, of that city, has been made. This system embraces the Elm Street line, the Pearl Street line and the Bryan and Live Oak suburbs line. The price paid George W. Davenport, of Middlesex, Mass., for the system was $150,000. Mr. Alexander now owns all of the electric street railway lines of Dallas except the Fairland line and rapid transit line.

Pacific Coast Notes.

San Francisco, Cal., Jan. 31, 1898

PROFESSOR N. S. KEITH, who resided here some years ago, and was one of the pioneers in dynamo and motor manufacturing, is in the city on a visit. He was a founder of the American Institute of Electrical Engineers.

THE SNOQUALMIE FALLS POWER COMPANY, of Seattle, Wash., was recently incorporated. Among the purposes of the corporation is included the long-talked-of supplying the city with electric power generated at the falls. Notwithstanding the long distance of transmission through a wooded country, the project is no doubt feasible. The capital stock is $500,000.

THE MINING FAIR was opened this evening (January 29) in this city at the close of the "Golden Jubilee" of mining in California. The jubilee was opened January 24, with a parade, participated in by about 20,000 persons. Floats, appropriate to the occasion and representative of the mining features of various sections of California, were prominently displayed. An immense arch, illuminated by electricity, spanned Market Street. At 8 P. M., January 29, President McKinley, in Washington, D. C., pressed the electric key that set the machinery in motion, and all San Francisco did the rest. All the city's whistles and bells responded to the signal. The fair will continue six weeks, occupying Mechanics' Pavilion. Three bells were mounted in a row in the Pavilion; one was a bell from Mission Dolores, San Francisco, 120 years old; the next was the old alarm bell of the Vigilantes of San Francisco, and the third was made for this occasion. Upon this last bell was received the electric signal from Washington, D. C. Fifty strokes of the bell were given, and then the machinery was set in motion, a little girl touching the key. Bells were rung simultaneously at the old mining camps. The San Francisco Gas & Electric Company wired the Mechanics' Pavilion and Rosenkrans & Co. wired the Mining Jubilee Arch.

French Notes.

(From Our Own Correspondent.)

Paris, France, Jan. 26, 1898.

ELECTROLYTIC ALUMINUM.—A study of impurities contained in industrial aluminum prepared by electrolytic methods, and in the alloys of this metal, recently made by M. Defacyz, goes to show that to-day the purest aluminum (99.5 to 99.7 per cent. pure) is prepared in France.

THE ELECTRIC FURNACE AND ALLOYS OF COPPER AND GLUCINUM.—These alloys have recently been obtained by M. Lebeau by reducing in the electric furnace a mixture of glucina and carbon in the presence of metallic copper. The alloys thus obtained are a beautiful golden yellow color, and have very similar properties to aluminum bronzes. They are extremely sonorous.

CALCIUM CARBIDE IN THE PREPARATION OF ABSOLUTE ALCOHOL.—M. P. Yvon has recently stated that if coarsely powdered carbide of calcium is placed in contact with concentrated alcohol (90 to 95 per cent.), the carbide is vigorously attacked and disengages acetylene so long as any water remains in the alcohol. When an anhydrous condition is reached disengagement ceases. By this means the employment of carbide of calcium furnishes a good test whether or not a sample of alcohol is anhydrous. To prepare absolute alcohol it suffices to put in a flask of 90 or 95 per cent. alcohol about one-quarter of its weight of carbide of calcium powder. The gas comes off at first very rapidly, and soon ceases to appear. By frequently shaking the flask during a period of several hours, and then letting it stand twelve or fifteen hours only a small quantity of acetylene is left in solution. In attempting the redistillation of the alcohol, it is wise to take great precautions with the first vapors disengaged, which consist of a mixture of alcohol and acetylene. The condensed alcohol is absolutely anhydrous. It is a good plan to collect all the alcohol in the same receiver, and to shake it up with a small quantity of dried sulphate of copper, which absorbs any acetylene left in solution. The second distillation then separates the alcohol from the acetylide of copper which is formed. Absolute alcohol prepared by this process is not precipitated by alcoholate of baryta. Calcium carbide is thus a more sensitive reagent than this last, and permits absolute alcohol to be obtained from one or at least two distillations.

General News.

NEW INCORPORATIONS.

THE OWOSSO TELEPHONE COMPANY, Owosso, Mich., has been organized with a capital stock of $20,000.

THE MACON TELEPHONE COMPANY, Macon, Mo., has been incorporated with a capital stock of $10,000. Among those interested are H. L. Gray, J. A. Hudson, Theodore Gray and others.

THE CITIZENS ELECTRIC LIGHT COMPANY, Lewiston, Mon., has been incorporated with a capital stock of $10,000. Among those interested are D. M. Crowley, C. F. Little and F. F. Wright.

THE TOLEDO & OTTAWA BEACH RAILWAY COMPANY, Toledo, Ohio, has been formed with a capital stock of $100,000. The incorporators are C. M. Spitzer, A. L. Spitzer, J. H. Doyle and C. T. Lewis.

THE CLINTON COUNTY TELEPHONE COMPANY, Carlisle, Ill., has been formed with a capital stock of $2500. The incorporators are G. Van Horbecke, J. C. Eisenmeyer, Thomas E. Ford, Otto Kock and W. S. London.

THE LURYE-LEWIS ELECTRIC PROTECTIVE COMPANY has been organized in New York City by H. J. Lurye, M. H. Lewis, Simon Schwarz and Joseph Schwarz, New York City. The capital stock of the new company is $5,000.

THE PEOPLE'S ELECTRIC LIGHT, HEAT & POWER COMPANY, Ocean City, N. J., has been organized with a capital stock of $50,000. The incorporators are George Pfeiffer, Jr., George Barrett and J. Rufus Eastlock, all of Camden, N. J.

THE MOORE TELEPHONE MANUFACTURING COMPANY, Newark, N. J., has been formed with a capital stock of $50,000, for the purpose of buying, selling and manufacturing switchboards and appliances. The incorporators are William E. Moore, Frank Travis and Joseph M. Thompson, of Brooklyn, and William P. Upson, of Glen Ridge, N. J.

THE CICERO & HARLEM RAILWAY COMPANY has been incorporated at Chicago, Ill., with a capital stock of $1,000,000. The board of directors includes D. H. Louderback, Benjamin C. Stidgert, Charles V. Weston, J. Charles Moore and Charles N. Whitehead. The company proposes to build a line of railroad from the east line of the town of Cicero, thence in a westerly direction to the west line of Cook County, and such branch lines as the company may need.

THE TELEGRAPH AND TELEPHONE.

MACON, MO.—The Macon telephone system has passed into the hands of a local syndicate, which will at once incorporate a company with a capital of $10,000.

NASHVILLE, TENN.—It is announced that the Cumberland Telephone Company will come into possession of the Great Southern Telephone Company's entire plant and interests.

LAWRENCE, MICH.—The County Telephone Exchange Company is being organized to build lines between Paw Paw, Bangor, South Haven, Lawrence and Hartford, supplying farmers along the line with the service.

BOWLING GREEN, KY.—A home telephone company is being organized. Mr. E. A. Higgins is at the head of the enterprise. The new concern will charge $2 per month for business houses and $1 for residences.

DETROIT, MICH.—The Detroit Telephone Company has closed a lease for two new local exchanges. It is stated that contracts for 1600 telephones now on hand cannot be filled owing to lack of facilities, which these two new exchanges are expected to supply.

SEYMOUR, IA.—The Seymour Telephone & Construction Company at a recent meeting elected Mr. J. H. Gunn, president; M. H. Wilson, vice-president; George Elmore, secretary; Leroy Ware, treasurer. The Seymour Telephone Company has completed its line to Centreville.

PITTSBURG, PA.—The Home Telephone Company has made arrangements with the members of the Interstate Independent Association to join the Pittsburg line on its completion. The Interstate Association includes all the independent companies of Western Pennsylvania and Eastern Ohio, and operates 10,000 instruments.

PITTSBURG, PA.—Prof. J. F. Ray, of Washington and Jefferson College, in Washington, Pa., has made a successful test of telegraphing without a wire. The transmitting and receiving apparatus were located at opposite ends of the building and communication was carried on between the two stations. Professor Ray intends to continue his experiments on a larger scale.

KEOKUK, IA.—The City Council of Fort Madison has finally agreed to allow J. C. Hubinger to run his telephone wires through that city, with permission to establish an exchange there in the near future. Mr. Hubinger agrees to give a bond of $2000 to take down the poles and wires at once if the people should fail to ratify the council's action at the spring election.

HUNTSVILLE, ALA.—The Southern Bell Telephone Company will make extensive improvements in its long-distance service as soon as the weather will permit. Huntsville is at present the extreme southern point of the system, Georgia towns excepted. Wires will be run from here to Decatur, Birmingham, Montgomery, Selma, Mobile, New Orleans and many towns in Eastern and Central Texas.

PONTIAC, ILL.—A local company has purchased the Livingston County telephone plant, and has increased the capital stock to $60,000. The company now operates exchanges at Pontiac, Forrest and Fairbury, and in the near future expects to reach all cities in this and adjoining counties. The gentlemen who compose the new company are W. E. E. Herron, J. S. Murphy, Mayor D. S. Myers, C. E. Legg and A. M. Legg, of Pontiac, and Hon. James Smith and Clinton Stanford, of Chatsworth.

ELECTRIC LIGHT AND POWER.

DES MOINES, IA.—Judge Bishop, of the Polk District Court, has declared the special municipal lighting election invalid, and the contract entered into with the McCaskey & Holcomb Company illegal.

CARROLLTON, GA.—The Carrollton Light & Power Company has recently purchased 60-kw Westinghouse alternators to replace 25-kw machines. The original equipment was installed by the Brush Company in 1893.

SCRANTON, PA.—The stockholders of the Electric Light, Heat & Power Company have elected directors, and their officers are as follows: President, Edward Clarkson; vice-president, E. W. Mills; secretary, George A. Herbert; treasurer, J. E. Watt.

WOODLAND, CAL.—There is a movement on foot in this city to organize and establish another electric power company. Nothing definite regarding the plans of the company can yet be obtained, however. It is reported that a power plant will be erected here.

NEW YORK CITY.—At the Board of Aldermen meeting February 1 the committee on docks and ferries reported favorably on a resolution to request the Dock Board to provide an electrical plant for lighting and heating the recreation pier on the East River, at a cost of $30,000.

SYRACUSE, N. Y.—At a meeting of the stockholders of the Electric Light & Power Company, of this city, the following named gentlemen were elected officers for the ensuing year: President, William Nottingham; vice-president, Charles M. Warner; secretary, George M. Barnes; treasurer, George W. Davenport; general manager, Warren H. Girvin.

NEW YORK CITY, N. Y.—Mr. Frank W. Hawley states that electricity will soon be introduced as a motive power upon all the canals of this State, the Champlain Canal being the first one to be so equipped. At the next meeting of the board of directors of the Cataract General Electric Company, Mr. Hawley will recommend the offer of a prize of $25,000 for the best plan submitted for the utilization of an electric current to the propulsion of a canal boat.

PARKERSBURG, W. VA.—Negotiations have been closed by which the Parkersburg Light & Power Company has bought out and absorbed the Parkersburg City & Suburban Street Railway Company. The name of the consolidated company is the Parkersburg Gas, Electric Light & Street Railway Company. The company will proceed to build a system of street railways, which was planned by the Parkersburg City & Suburban Street Railway Company. The following gentlemen were elected officers: President, C. H. Shattuck; vice-president, C. C. Martin; secretary, W. W. Van Winkle; treasurer, J. M. Jackson, Jr.

SAULT STE. MARIE, MICH.—The Edison-Sault Electric Company will soon begin the construction of a 4-foot conduit through which to carry wires from its power house to the south side of the Government canal. The conduit will be made of five-sixteenths-inch steel, and will be laid 1 foot below the bottom of the canal. It will be 375 feet long, and will weigh about 59,000 pounds. It will be covered over with cement, thus avoiding all possibility of accidents from passing boats. Telegraph and telephone wires will be run through the conduit, as well as the wires of other local manufacturing concerns.

THE ELECTRIC RAILWAY.

TRENTON, N. J.—The Trenton Passenger Railway Company will probably build a trolley line to Hamilton Square.

RICHMOND, VA.—Francis Seymour, of Paterson, N. J., has secured a franchise for an electric railway at Richmond, Va.

SOMERVILLE, N. J.—The New York & Philadelphia Traction Company has petitioned the Town Commissioners for a franchise.

WHEELING, W. VA.—The Wheeling & Elm Grove Railway Company will probably change its motive system from steam to electricity.

BROOKLYN, N. Y.—The Kings County Electric Light & Power Company, it is stated, will erect a new plant on Gold Street, near John.

DIGHTON, MASS.—The Providence & Taunton Electric Railroad has petitioned for right of way through the streets for an electric line.

LOWELL, MASS.—Albert H. Wilder and others petitioned for incorporation as the Fitchburg & Ashby Street Railway Company. Capital, $25,000.

BALDWINSVILLE, N. Y.—The Baldwinsville Railroad Company has petitioned the Board of Village Trustees for a franchise to operate its road in this city.

BALTIMORE, MD.—The Consolidated Railway has been granted a franchise by the City Council for permission to operate its lines through the streets of the city.

WILKESBARRE, PA.—A trolley line is to be built from Hazleton to Wilkesbarre. The Wyoming Valley Traction Company, of Wilkesbarre, will build the line.

MAMARONECK, N. Y.—It is proposed to build a trolley road from this place to connect with White Plains. Local capitalists will petition the Village Trustees for a franchise.

NEWARK, OHIO.—The County Commissioners have granted a franchise to the Columbus & Buckeye Lake Street Electric Railway Company to construct an electric line from Newark to Hebron.

ALBANY, N. Y.—The State Railroad Commission granted an application of the Delaware Terminal Railroad Company for permission to build its electric road from the village of Sidney to Franklin, Delaware County.

HANNIBAL, MO.—The bonds for the extension of the Hannibal Traction Company's line will soon be issued, and the road improved to handle the traffic now offered. New attractions in the way of parks will be established, and a line built to the famous "Hannibal Cave" in the suburbs. G. W. Chance, 14 S. Broad Street, Philadelphia, and D. Thompson, of Hannibal, Mo., are interested.

PALMYRA, N. Y.—The projected electric railway between Palmyra and Marion is being revived. Mr. W. A. Powers, who is at the head of the en-

terprise, stated that the road will be pushed through this summer. There is a large trade at Marion, which is carried on by draying and hauling, and it is thought that the freight receipts of the new road will alone pay the operating expenses.

VINCENNES, IND.—The Wabash & Mississippi Construction Company lately organized to build an electric railroad from Vincennes, Ind., to St. Louis, Mo., on the line of the old State road, is rapidly pushing the work of securing the right of way. The company agrees to maintain bridges and culverts and keep its tracks macadamized for two feet on either side. The use of the Leffler electromagnetic system is contemplated.

MARLBORO, MASS.—Plans are ready for the extension of the electric railroad from its terminus in South Street, Chelmsford Centre, to points beyond Marlboro. A line from Marlboro through West Concord, Concord and Carlisle, to unite with the present line at Chelmsford Centre, is also contemplated. Active promoters of this enterprise are residents of the towns mentioned. Mr. Henry S. Perham will represent the town of Chelmsford.

BRIDGEPORT, CONN.—The Supreme Court of this State has decided that the appeal of the New York, New Haven & Hartford Railroad Company from the decision of Judge Wheeler, of the Superior Court, in the matter of the building of the Shelton Electric Railway, cannot be allowed. The Consolidated road made a bitter fight against the Shelton electric railway because the latter will parallel the Consolidated lines. The work of building the Shelton line will now be pushed as rapidly as possible, and before the summer is over Bridgeport, Ansonia and other towns of the Naugatuck Valley will be connected by trolley lines.

Legal Notes.

THE ANCHOR ELECTRIC COMPANY, of Boston, writes that by its treasurer, Norman Marshall, it has brought suit for $25,000 damages against its retiring president, H. C. Hawks, for breach of contract and interference with its business and employees. An injunction was granted by Judge Holmes, of the Supreme Judicial Court, on February 2, restraining Mr. Hawks from further interference with the business and employees of the Anchor Electric Company.

TROLLEY DECISION.—Judge Lacombe, in the United States Circuit Court for the Southern District of New York, on February 7 handed down an opinion in the case of the Thomson-Houston Electric Company v. the Union Railway Company for a preliminary injunction under Claims 2 and 4 of the Van Depoele patent No. 495,443. The judge states that the defendant's device is practically a duplication of that used by Van Depoele in New Orleans in 1885, and therefore an infringement. The device in question is the pivoted, underneath-contact trolley arm.

THE RAILWAY MOTOR SUSPENSION CASE.—The decree of Judge Wheeler in the suit of the Sprague Electric Railway & Motor Company v. the Union Railway Company and the Walker Company grants a perpetual injunction against the defendant companies, restraining them, with the exception of the equipments at present in use by the Union Railway Company, from making, using or vending apparatus embodying the subject matter of the combination of the second, sixth and ninth claims of Mr. Sprague's patent No. 324,892 of August 25, 1885. This suit in reality was brought by the General Electric and Westinghouse Companies, and was defended by the Walker Company. Officers of the Walker Company deny that Judge Wheeler's decision will have any effect on their motor business. Their railway motors, they claim, do not infringe the Sprague patents, and it is the company's intention to continue their manufacture. It proposes to appeal the case in order that the decision may not stand against the company's interests.

Personal Note.

MR. MARTIN E. HERSHEY, manager of the Harrisburg Foundry & Machine Works, Harrisburg, Pa., has resigned that position. Mr. Hershey was connected with the works for fifteen years.

Obituary Note.

WILLIAM HABIRSHAW, only son of Dr. W. M. Habirshaw, of the India Rubber & Gutta Percha Insulating Company, Yonkers, N. Y., died on Sunday morning, January 30, of pneumonia, with which disease he had been ill for about a week. Young Mr. Habirshaw was brought up in the wire insulating business under his father's training, and is said to have been one of the best informed men in that line. He was highly esteemed by all who knew him, and the many friends of Dr. Habirshaw extend to him their sympathy in his bereavement.

Trade and Industrial Notes.

THE ESTABLISHMENT of Messrs. Ness, McLaren & Bate, at 749 Craig Street, Montreal, Que., was recently damaged by fire. The firm has taken temporary premises at 761 Craig Street.

MR. FRANK G. BROWN, JR., district agent for the Fort Wayne Electric Corporation at Rochester, N. Y., informs us that his office has been moved to Room 717, the Dillage Building, Syracuse, N. Y.

THE WESTERN ELECTRIC COMPANY manufactures a very superior disc Leclanche porous cup cell, especially adapted for bell and annunciator work. It makes the batteries complete or furnishes the porous cup without zinc or glass jar.

"BIG BELTS" is the title of a folder just issued by Messrs. C. A. Schieren & Co., New York, the well-known manufacturers of leather belts. The folder gives a long list of large belts made by this concern, together with half-tone illustrations of the same.

THE NUMBER OF ARC LAMPS manufactured and shipped from the factories of the General Electric Company within the past fiscal year has exceeded 24,000. Many thousands of the General Electric enclosed arcs are now in service, and in the introduction of the alternating enclosed lamp has still further increased the sales.

THE MANUFACTURERS & INVENTORS ELECTRIC COMPANY, 96 Fulton Street, New York, of which Mr. T. J. Smith is manager, makes experimental work its chief specialty. The concern carries a large stock of electrical supplies, and business is expanding so rapidly that it has been necessary to increase the working force of the concern.

A TEMPERED COPPER PAPER KNIFE.—We have received from the Mansfield Tempered Copper Company, Mansfield, Ohio, a neat desk implement in the form of a paper knife or envelope opener. It is made of pure tempered copper. Its handle is in the form of a commutator bar, having a horn-shaped extension, with cutting edges. It is very handy for the desk or table.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, Ohio, has just received through its Berlin office an order for a planer and drill press to go to Cassel, Germany; also an order for lathes, automatic screw machines and radial drills for a manufacturing concern at Duesseldorf, Germany. Both of these German establishments are large builders of locomotives, etc.

MR. JOKICHI TAKAMINE, 511 Chamber of Commerce Building, Chicago, is sending out to his clients and others a copy of the Japanese law of design patents. Mr. Takamine is attorney for Japanese patents, trade-marks, etc. Owing to the application of modern ideas and methods in Japan, the patent business with reference to that country promises to assume large proportions.

DUNCAN METERS is the subject of a neatly gotten up catalogue just issued by the Fort Wayne Electric Corporation, Fort Wayne, Ind. Integrating meters for alternating currents are described and illustrated. The catalogue includes besides these descriptions of lamp and ampere-hour meters, equivalent rate meters, integrating wattmeters, together with directions for installing and using the various apparatus.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., note the tendency of the trade to favor a high grade article. All of their goods are made of the very best material, and are fully guaranteed in every respect. They claim that owing to the greatly increased demand for their products they are enabled to turn out a first-class article at a moderate price. "Good goods at reasonable prices" has always been their motto.

SOME OF THE LARGEST INDEPENDENT TELEPHONE COMPANIES throughout the United States have, we are informed, adopted the "O. K." dry battery, which is manufactured by the Non-Polarizing Dry Battery Company, 625 Broadway, New York City. Not only are the telephone companies adopting this battery, but several of the most prominent railroads have found it superior to others for their purpose.

THE C & C ELECTRIC COMPANY, New York, has issued three bulletins of its various types of apparatus. One is devoted to iron-clad dynamos and motors, another to bipolar dynamos and motors, and the third to multipolar dynamos and motors. Each contains illustrations of the machines under consideration, and tables giving their general dimensions. The bulletins are of uniform and convenient dimensions, and of neat production.

CORED CARBONS and solid carbons for enclosed arc lamps, manufactured by the Washington Carbon Company, Pittsburg, Pa., are attracting considerable attention. The company claims that its goods are equal to any on the market, and in support of this fact it points to its increase of business. It supplies customers in any quantity, even if it is necessary to break packages. The company caters to small and large trade, and is prepared to ship quickly.

THE SWARTS METAL REFINING COMPANY, Chicago, informs us that it is not in any way connected with the Swarts Iron & Metal Company, which recently sold out its business. The similarity of names caused some confusion in the trade, but there was no relation whatever between the two houses. The Swarts Metal Refining Company wishes to notify the trade that it is still doing business of the old stand, and is ready to fill any orders.

THE MAGNOLIA METAL COMPANY, New York, received through the mails during the last three or four months nearly 3000 testimonials on Magnolia metal. These testimonials came from every part of the United States and Canada, and were sent in by all classes of establishments using machinery. It has been estimated that at least 100,000 concerns in the United States and Canada are to-day using Magnolia metal. The Magnolia Metal Company's foreign trade is stated to be fully as large as its home trade.

THE MICHIGAN PIPE COMPANY, Bay City, Mich., in a little catalogue just issued, gives much interesting information about the Bethell process of treatment of wooden conduits to insure their preservation. This company manufactures creosoted wood conduits for underground wires, cross arms, poles, lumber, railway ties, etc. These conduits do not require a foundation of concrete. Recent examination of conduits of this kind laid down in Brooklyn, N. Y., in 1884, showed them to be free from any signs of decay.

CATALOGUE OF VALUABLE PAPERS.—Messrs. Munn & Co., New York, have issued a catalogue of papers published in the *Scientific American Supplement*. The catalogue is bound in cloth, and is very conveniently gotten up. The titles of the general subjects are printed in full-face type, and cross references in small capitals. The list includes over 10,000 of the more important articles published in the *Scientific American Supplement*. A copy of this catalogue will be found useful and valuable to engineers and mechanics.

AMONG THE RECENT SALES of the Fischer Foundry & Machine Company, Pittsburg, Pa., of its four-valve, centre-crank, automatic engine, are the following; Newton Electric Light & Power Company, Newtown, Pa., one 150 horse-power; the Union Traction Company, Philadelphia, Pa., one 40 horse-power; Standard Electric Light, Heat & Power Company, Avoca, Pa., one 150 horse-power; Jersey Shore Electric Co., Jersey Shore, Pa., one 125 horse-power; I. E. Cochran, for the Holland & Lake Michigan Street Railway Company, Chester, Pa., one 300 horse-power; Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Ia., one 350 horse-power.

THE MARVIN ELECTRIC DRILL COMPANY, Canastota, N. Y., has just issued its catalogue B on the subject of rock drilling by electric percussion drills. Some general remarks on electric rock drills are given, and these are followed up by an excellent description and various illustrations of the Marvin electric drill. The system includes a generator, which is remarkably simple in

design, and is said to be highly efficient in its operation. The advantages of installation and operation of this system are fully set forth, and anyone interested in this line of work will learn a great deal about the modern method of drilling by securing a copy of this catalogue.

"SURE CURE FOR STEAM, WATER AND FUEL WASTES" is the title of a sixty-four-page catalogue descriptive of the entire line of Bundy steam specialties, comprising steam traps, gravity pumps, steam and oil separators, feed water heaters, exhaust heads, safety water columns and Bundy's cement felting insulation. The catalogue will be ready for mailing in about ten days, and any one interested can obtain a copy by addressing the A. A. Griffing Iron Company, 66-68 Centre Street, New York, or the Boston or Philadelphia agencies, or the company's works in Jersey City. The catalogue will be designated "EE," and these letters should be specified when requesting a copy.

MESSRS. FRASER & CHALMERS, Chicago, Ill., have just issued the fourth edition of their catalogue No. 24, which is devoted to Riedler pumps, compressors and blowing engines. It is a very complete production of its kind, and contains much engineering information, which will be valuable for quick reference. This firm manufactures a line of electrically driven pumps which possess superior advantages on account of their high rotative speed. The catalogue is excellently illustrated with half-tone engravings and sectional and plan drawings of the many varieties of pumps manufactured by this firm. Riedler air and gas compressors form the subject of another and profusely illustrated catalogue just issued by the same firm.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., manufactures a full line of sheet metal machinery, and during the last two years has paid a good deal of attention to special presses for electrical work. It has recently supplied two of its large double-crank presses to the General Electric Company, Schenectady, N. Y., and four of the same style of presses to the Westinghouse Company, Pittsburg, Pa. These have proved very desirable for cutting out large armature discs. They are heavy and built in the most careful manner, and with a number of improvements in the adjustments and arrangements of long strokes, etc., which are highly appreciated by the superintendents of the factories named. The company is also building some new forms of machines for notching armature discs.

SEARCHLIGHTS ON THE YUKON RIVER STEAMERS.—The Carlisle & Finch Company, Cincinnati, Ohio, furnished many of the searchlights used on the Yukon River steamers. The steamers "Charles T. Hamilton," "John Cudahy" and "T. C. Powers" are equipped with this firm's lights. The large passenger steamer, "City of Seattle," running from Tacoma to Alaska ports, is also equipped with Carlisle & Finch lamps. A great many more of their lamps are placed on other steamers plying between Alaska and Pacific Coast ports. The penetrating power of the light from these lamps is such that they are being adopted by all the largest river and lake vessels. Messrs. Carlisle & Finch have a large number of orders on their books, and many more in prospect when navigation on the lakes and rivers opens up in the spring.

THE WYCKOFF WATER PIPE, made by the Michigan Pipe Company, Bay City, Mich., is said to be proof against electrolytic action. There are about 35 miles of this pipe placed underground in Bay City, the first having been laid in 1872. According to information submitted, not a single foot of this pipe has ever suffered from electrolytic action. The pipes are provided with thick wooden shells, and there is no continuous metallic path for the electric current, as the banding in each length is separated by a space of about 1 inch. In Tonawanda and North Tonawanda, N. Y., there are about 45 miles of Wyckoff pipe, and this has shown entire immunity from corrosion, notwithstanding that there are four electric railways in these towns. Similar reports are made respecting the water pipes laid down at Ishpeming, Mich., where the soil is strongly impregnated with metallic salts.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., is preparing plans for the construction of a power house and several large factory buildings near the Waverly station of the Pennsylvania Railroad. The plant is designed to be the largest of its kind in the world, and will be devoted to the manufacture of electrical implements and machinery. It is stated that a number of new inventions in the electrical line are to be produced in the new shops. The work of erecting the buildings will probably be commenced early in the spring. The plans, however, are not yet sufficiently far advanced to state with accuracy just how extensive the plant will be. The undertaking will be conducted by three companies, which are nominally separate concerns. Two have already been organized and a third is now being formed. The Electrical Implement Company has purchased a large tract of land near Waverly, and it is on this that the new establishment will be erected. The company owns a large tract of land in the locality, and there is an abundance of water on the property. The health of Mr. Edward Weston is said to be a factor in the plans of the new enterprise.

Business Notices.

FORECLOSURE SALE.—Opportunity for investors is offered in a well equipped electric lighting power and street railway plant at Lynchburg, Va. The plant is offered at foreclosure, to be sold February 28. Address Tyree & Wilkins, Lynchburg, Va.

A GOLDEN ERA is the title of an illustrated pamphlet issued by the general passenger department of the Chicago, Milwaukee & St. Paul Railway on mining in Colorado, California and other Western States. Klondike is an illustrated folder about Alaska and its gold mines, with rates of fare and information as to how to get there and what to expect after arrival. Both publications may be had free of expense by sending four (4) cents in stamps to pay postage to George H. Heafford, General Passenger Agent, Chicago, Ill.

Illustrated Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 1, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

598,092. ALTERNATING CURRENT MOTOR; A. Heyland, Frankfort-on-the Main, Germany. App. filed Dec. 29, 1896. The method of producing phase difference between the two inducting circuits of an alternating current motor, which consists in causing one of said circuits to be powerfully affected by the reaction of the secondary member of the motor, while reducing the effect of the said reaction upon the other circuit.

598,097. ELECTRIC CONTROL DEVICE FOR ELEVATORS; J. D. Ihlder, Yonkers, N. Y. App. filed April 18, 1896. The combination with an elevator operating mechanism and a control device therefor, of a control motor and an electromagnetic clutch, the clutch being provided with teeth.

598,099. STATION INDICATOR; D. C. and J. M. Jones, St. John, Ky. App. filed March 26, 1897. In a station indicator, an endless station indicating strip mounted on rollers, a spring actuated train of gearing to operate one of said rollers, an escapement lever at the end of said train farthest from the actuating spring, a magnet and an armature to primarily operate the escapement lever to permit a partial movement of the train of gearing and to again stop it until the armature is released, a spring to retract the lever when the current is broken and again release the escapement wheel, and means to hold the escapement lever out of engagement with the escapement wheel until the necessary movement of the train of gearing is completed.

598,106. FUSIBLE CUT-OUT; E. A. Lowe, North Plainfield, N. J. App. filed March 5, 1897. The combination with the circuit wires, of spring terminals, one permanently connected to each wire independent of any support, a box having an opening through it and threaded upon the insulated wires and receiving and holding the spring terminals within it, and a removable plug and fusible strip therewith connected, inserted into the box with the fusible strip in contact with such terminals.

598,109. INSULATING ATTACHMENT FOR ELECTRICAL CONNECTORS; R. P. and J. D. Osgood, Methuen, Mass. App. filed June 28, 1897. An insulating attachment for an electrical connector, comprising a rigid tubular jacket of non-conductive material and of shape to inclose the connector; and tubular elastic tips of non-conductive material, each adapted to have one end stretched around one end of the jacket, and the other hug closely around the wire, whereby the waterproof connection is made between the wire and the jacket at each end.

598,160. ELECTRIC FIRE ALARM, CIRCUIT AND SIGNAL BOX; L. G. Rowand, Camden, N. J. App. filed Jan. 5, 1897. In an electric fire alarm system, a main-line circuit, a plurality of boxes, each having signaling devices in circuit with the main-line circuit, a spring actuated wheel for operating the signaling devices, an escapement connected with said wheel, an escapement pawl operating with the escapement, an electromagnet in circuit with the signaling devices, a device carried by the armature adapted in the retracted position of the armature to lock said escapement, a wheel in connection with the spring actuated wheel provided with a detent, a projection carried by said armature adapted in the retracted position of the armature to enter said detent.

598,172. TELEPHONE SYSTEM; C. A. Barron, R. T. Reid and J. L. McDonnell, Tacoma, Wash. App. filed April 5, 1897. In a telephone system, the combination with a party line and a series of telephones thereon, of a switch for each telephone an electromagnetic locking device for each switch, and included in a normally closed local circuit, and means whereby to maintain the circuit of said locking device open circuited when the lever is in use, whereby to prevent all of said switches except the one belonging to the telephone in use, from being closed.

598,183. TELEPHONE SYSTEM; R. T. Reid and J. L. McDonnell, Tacoma, Wash. App. filed May 7, 1897. In a telephone system, the combination with the line, a series of telephones thereon and lock-out devices for said telephones, of a normally open circuit for each telephone, a normally open circuit for each lock-out device of higher resistance than the telephone circuit and a switch arm common to both of said circuits.

598,184. CONDUCTOR FOR ELECTRIC RAILWAYS; G. Ritter, Stuttgart, Germany. App. filed Oct. 16, 1896. In a three-wire electric railway system, the combination, with a series of pairs of contact devices, the corresponding contact devices of all the pairs being connected to one bus conductor, and the remaining contact devices to the other bus conductor, of a car and a shoe carried by the car and arranged to make electric contact with one series of corresponding contact devices when traveling in one direction, and with the other series of corresponding contact devices when traveling in the opposite direction.

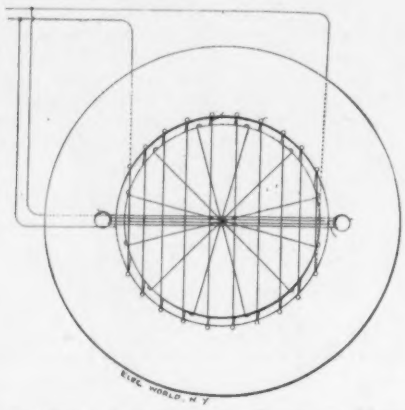
598,198. ELECTRIC LAMP FOR BICYCLES; P. A. Dowd, Boston, Mass. App. filed July 10, 1897. The combination with a bicycle, of an electric translating device carried thereby, and a current generator for said translating device having its armature journaled in non-magnetic pieces attached to the sides of the field magnets, a frictional wheel attached to said armature substantially at its longitudinal centre, and a support for said field magnets attached to the bicycle frame, and to which said field magnets are adjustably secured to enable the said friction wheel to engage the periphery of a wheel of the said bicycle.

598,199. MECHANISM FOR STARTING, STOPPING AND CONTROLLING SPEED OF MOTORS OF ELECTRIC CARS; F. H. Foster, Brooklyn, N. Y. App. filed Aug. 12, 1897. The combination, with an electric motor, a current controller therefor, and means through which an electric current may be passed to them, of an electromagnet, a conductor for leading an electric current thereto, a switch through which the flow of this

current may be permitted and interrupted, as required, and mechanism intermediate the electromagnet and the controller, whereby the said controller may be automatically operated from the electromagnet to start and control the speed of the motor, when the switch is operated in the required direction.

598,208. ELECTRIC METER; C. D. Raab, Kaiserslautern, Germany. App. filed Dec. 30, 1896. A motor wattmeter for alternating currents, provided with one or more metallic rotary armatures acted upon by two sets of magnetic fields having each a difference of current phase, one of said sets being produced by the main or direct current, and the other by two shunt currents.

598,209. ELECTRIC METER; C. D. Raab, Kaiserslautern, Germany. App. filed June 24, 1897. A motor wattmeter for alternating currents having a rotary armature without current supply and a coreless solenoid, in combination with two coreless shunt field coils of like polarity, so arranged as to form a common magnetic field.

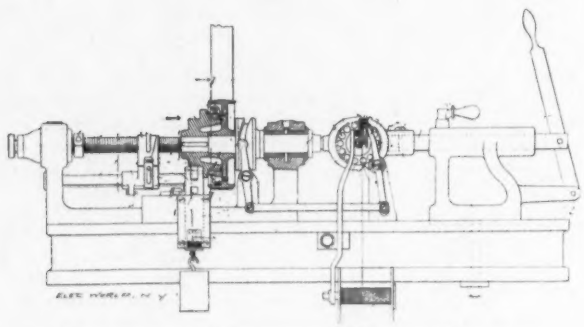


No. 598,092.—Alternating Current Motor.

598,260. ELECTRICAL CONDUCTOR; J. C. Werner, Broadbrook, Conn. App. filed June 15, 1897. The combination with a line of way, of an electrical conductor extending along such line; means for supporting the conductor; a pair of connecting members secured, respectively, to the conductor at different points in the latter, and having a working face substantially continuous with that of the conductor; and resilient connecting means between said members.

598,269. POLARIZED SIGNAL BELL; F. R. McBerty, Downer's Grove, Ill. App. filed Nov. 24, 1896. The combination with an electromagnet, the armature therefor and a circuit, including the windings of the magnet, of a helix connected with the same circuit inclosing some portion of the magnetic circuit of the magnet, and acting differentially thereto, and a closed conducting circuit of low resistance surrounding the magnetic circuit between the said winding and the said magnetic circuit, whereby the magnet is rendered inert as to continuous currents in its windings, but it remains responsive to varying currents.

598,271. BRUSH HOLDER; A. J. Oehring, Chicago, Ill. App. filed June 30, 1896. In a commutator brush holder for dynamo-electric machines, the combination with an opening or socket in which the brush is easily inserted, of a spring adapted to bear upon the brush and yieldingly force it into engagement with commutator, a standard, a collar mounted upon the said standard to which one end of the spring is secured, and engaging threaded parts provided upon the said standard and collar affording a rack-and-screw adjustment, whereby the tension of the spring is regulated.



No. 598,273.—Instrument Winding Device

598,272. INSTRUMENT WINDING DEVICE; A. J. Oehring, Chicago, Ill. App. filed Oct. 12, 1896. The combination of a rotatably mounted chuck having a curved receiving jaw adapted to receive a body of curved cross-section having a recess, and a lug projecting from said jaw adapted to enter said recess.

598,273. INSTRUMENT WINDING DEVICE; A. J. Oehring, Chicago, Ill. App. filed Nov. 28, 1896. In a drum armature winding machine, the combination with an oscillating guide for guiding the wire upon the core, of means for relatively rotating the armature core, and guide for the purpose of winding wire upon the core, and means for oscillating said guide upon each relative revolution of the armature core, whereby the armature wire may be laid about the shaft of the armature.

598,276. SELF-RESTORING ANNUNCIATOR; J. Steiner, Brooklyn, N. Y. App. filed May 23, 1896. The combination with the supporting plate, of the cores of the restoring electromagnet secured thereto by means of screws passing through the retaining plate and into the end of said cores, a drop provided with pins adapted to fit into slots provided in the ends of said cores, and screws passings into the ends of said cores to maintain said pins within the slots.

598,285. TELEPHONE APPARATUS; F. B. Cook, Chicago, Ill. App. filed March 25, 1895. Renewed Dec. 16, 1897. In a telephone switchboard, a plurality of line circuits converging at each board, a series of main spring jacks, one for each circuit, by which the connections are established between the different line circuits by means of main cords and plugs and a series of auxiliary or supplemental spring jacks, one for each of said circuits, together with a repeating coil, included in a supplemental cord circuit having a supplemental plug, whereby the repeating coil may be looped and included in anyone of the circuits aforesaid terminating at the switchboard, by insertion of the supplemental plug in either one of the supplemental spring jacks of the connected circuit.

598,303. ELECTRIC HEATER; E. E. Cruzen, Baltimore, Md. App. filed Aug. 7, 1896. An electric heater for drying canals in the roots of teeth, comprising an insulated hand-piece, two wires of an electric circuit passing through the handpiece and projecting from one end thereof, and covered and lashed together by an insulating wrapper and a wire loop extremity of said circuit of higher resistance; and a metal probe attached by one end of sai l high resistance extremity and having a flexible point, whereby the probe may be inserted in the root canal and heated by an electric current.

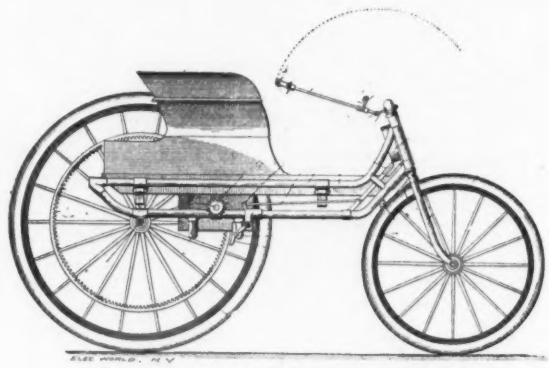
598,314. AUTOMOBILE VEHICLE; W. A. Crowdus, Chicago, Ill. App. filed Oct. 9, 1896. In an automobile vehicle, the combination of a motor, a driven wheel or wheels mounted upon a shaft or shafts, and friction clutch mechanism adapted to be automatically actuated by centrifugal force to set the frictional clutch mechanism and engage the motor shaft with the driven wheel or wheels.

598,316. ELECTRIC GAS LIGHTING APPARATUS; C. Eickmann, Indianapolis, Ind. App. filed July 3, 1897. A gas igniting apparatus, comprising a vessel having an explosion chamber adapted to be connected to a furnace and from which a flame may be propelled into a furnace, a duct between said chamber and a supply pipe, a valve in said duct, electrodes in said chamber electrically connected, and means by which said electrodes may be connected in an electrical circuit, and said circuit broken automatically by operating the main supply valve.

598,328. TERMINAL HEAD FOR ELECTRICAL CONDUCTORS; C. H. Sewall, Chicago, and H. E. Procunier, Oak Park, Ill. App. filed Aug. 22, 1896. A stem of conducting material forming part of an electric circuit projecting from the outside surface of a base or holder, and surrounded by a non-conducting bushing; a metallic connector mounted on the bushing; means for interposing another part of an electric circuit to complete upon one side of base or holder the circuit between stem and connector.

598,358. ELECTRIC CIRCUIT CONTROLLER; W. T. Budds, Charleston, S. C. App. filed Aug. 30, 1897. An electric circuit controller comprising a wheel of conducting material having peripheral projections on its body portion, and a plain segmental portion at one side of less length circumferentially than the body portion, and the wheel being cut away at one side of the segmental portion, the area of the cutaway portion being equal to that of the segmental portion.

598,410. FIRE AND BURGLAR ALARM SYSTEM; C. P. Bostian, Milton, Pa. App. filed April 27, 1897. In a fire and burglar alarm system, a series of alarm boxes connected in multiple in a normally open circuit extending throughout the apartments to be protected, each alarm box having a clock work, a circuit closing signal wheel provided with groups of pins, a spring contact arm, a projecting tooth on the wheel, a stop lever, an arm for operating the stop lever through intermediate connections, and two springs normally holding said stop lever in the path of the tooth, but permitting the arm to be moved in either direction to disengage the stop lever from the tooth.



No. 598,314.—Automobile Vehicle.

598,489. ELECTRIC CIGAR LIGHTER; W. F. Kessler, Auburn, Ind. App. filed July 22, 1897. A cigar lighter, comprising an electric circuit, a supporting tube, a wick tube pivoted to said supporting tube and forming one terminal of said circuit, in combination with an insulated bracket secured to said supporting tube and longitudinally adjustable with reference to said wick tube, a spring actuated sparking lever, fulcrumed in said bracket and projecting into the path of said wick tube and forming the opposite terminal of said circuit, and a reactionary spring extending across the path of said sparking lever to take up its rebound.